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4. Moving Boat

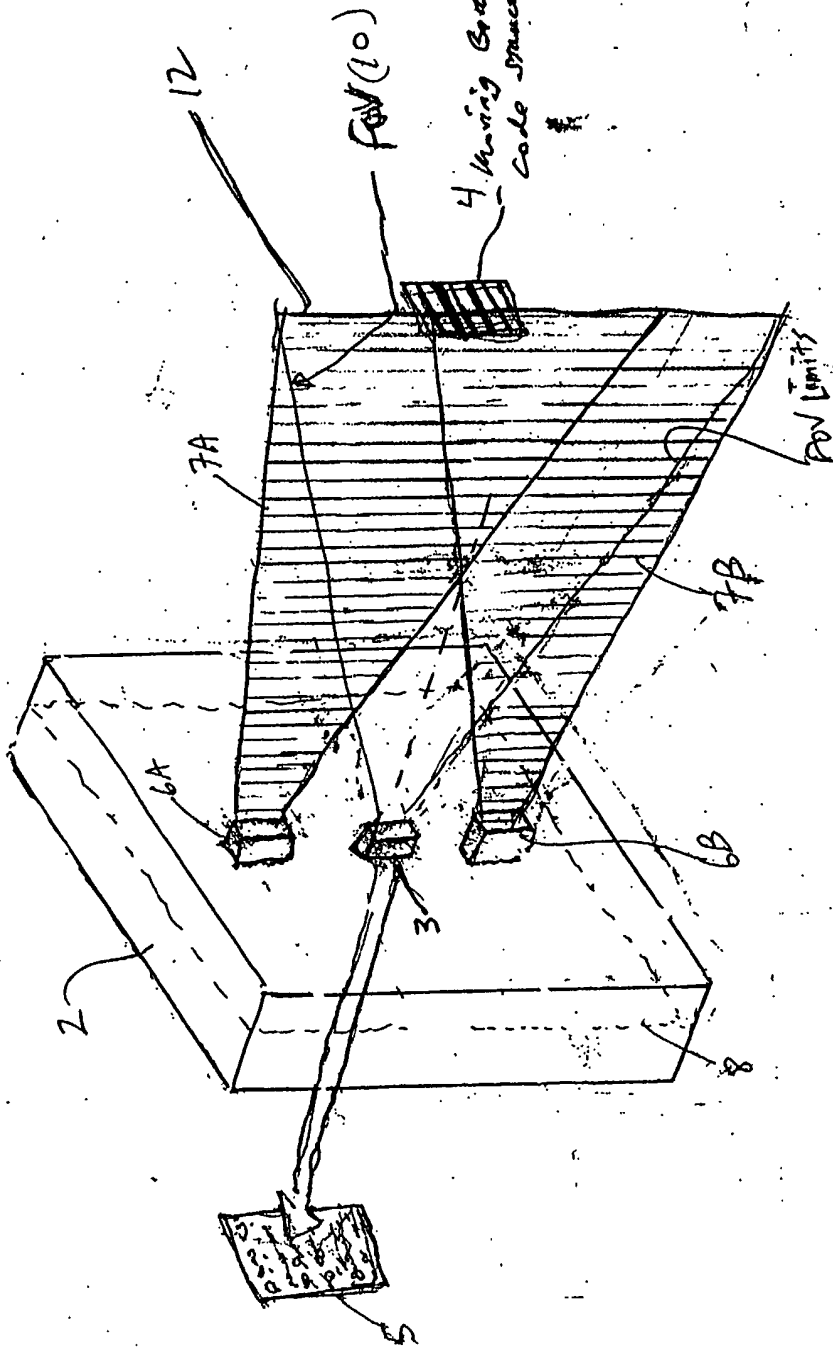
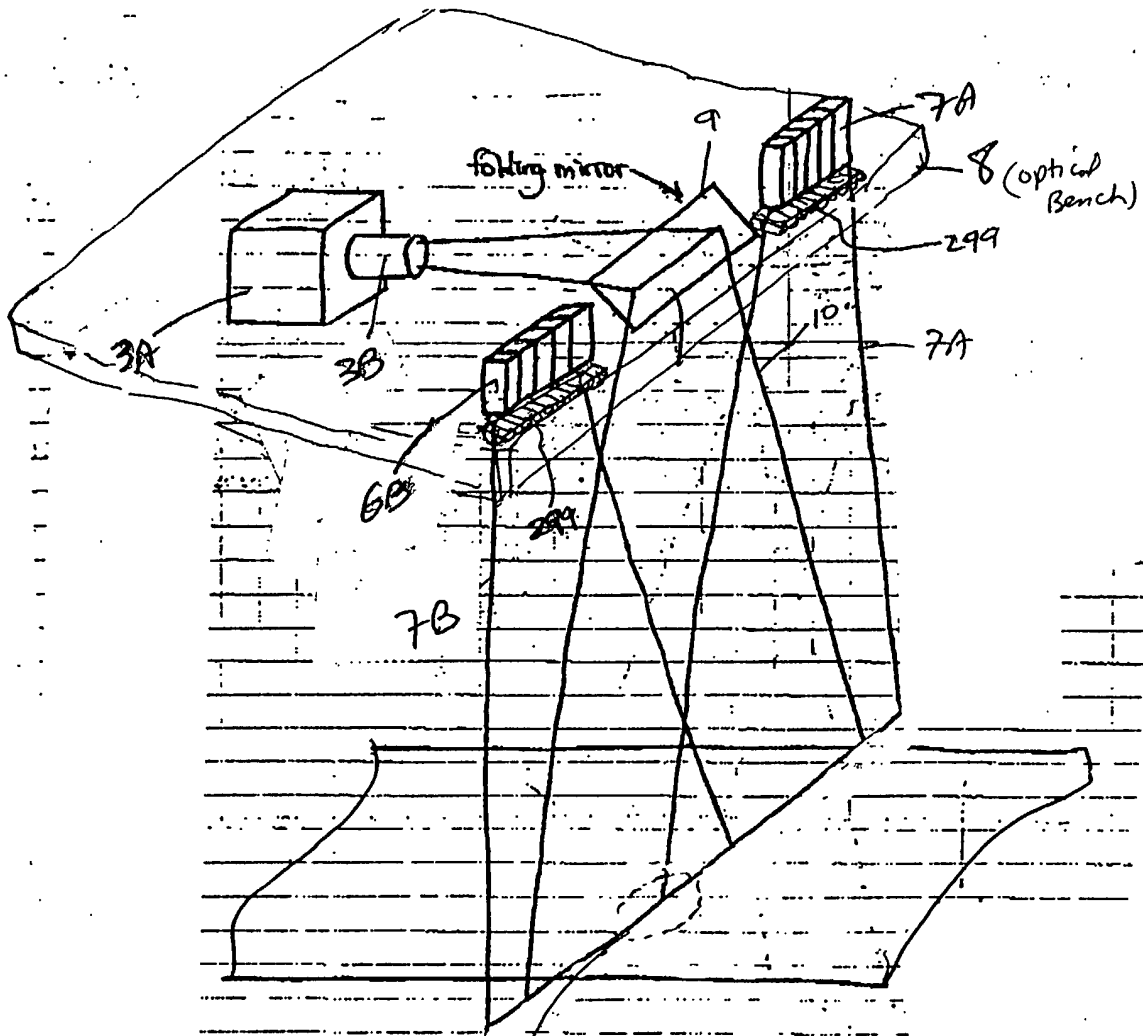


FIG 1A

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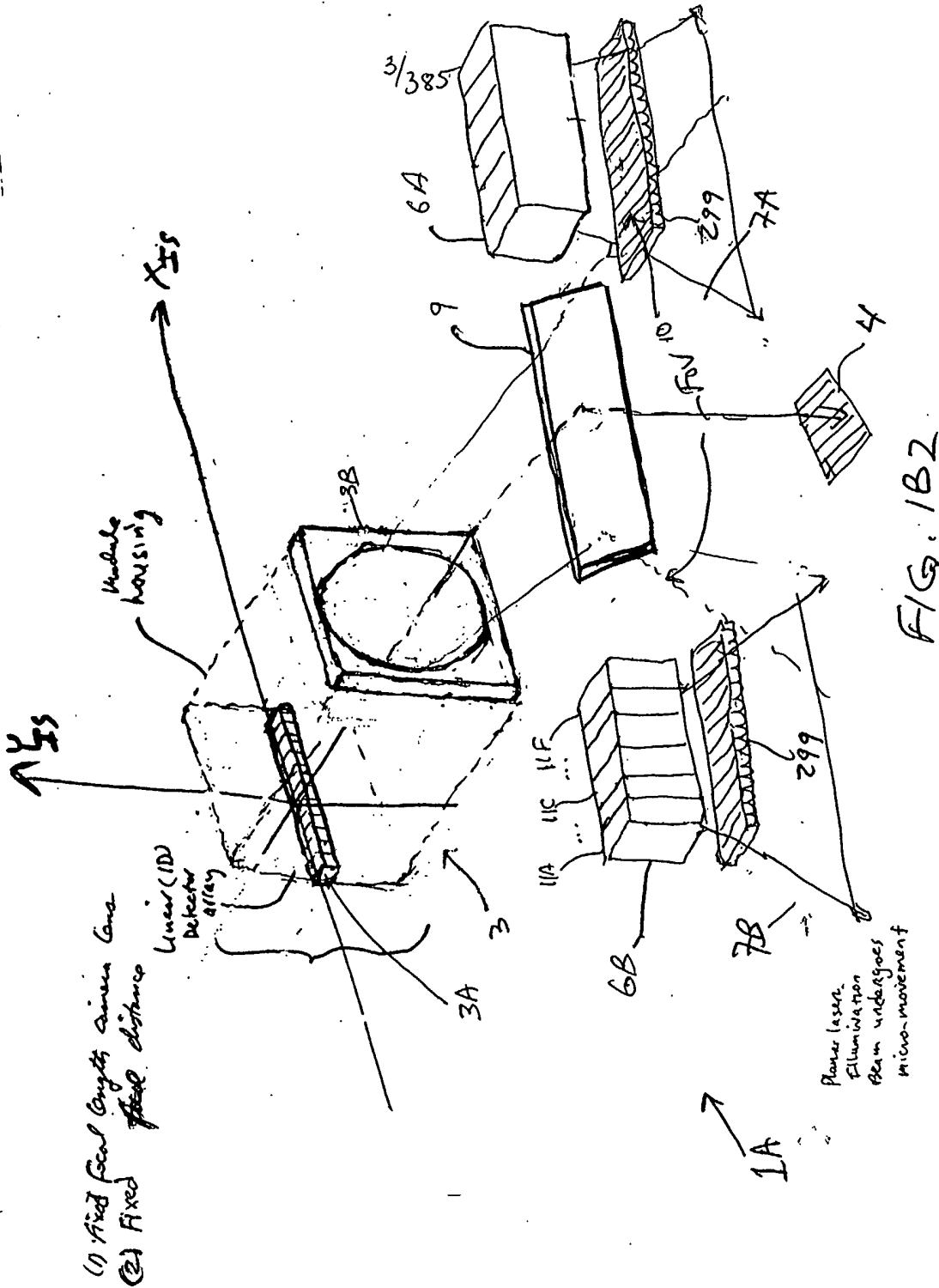


1A

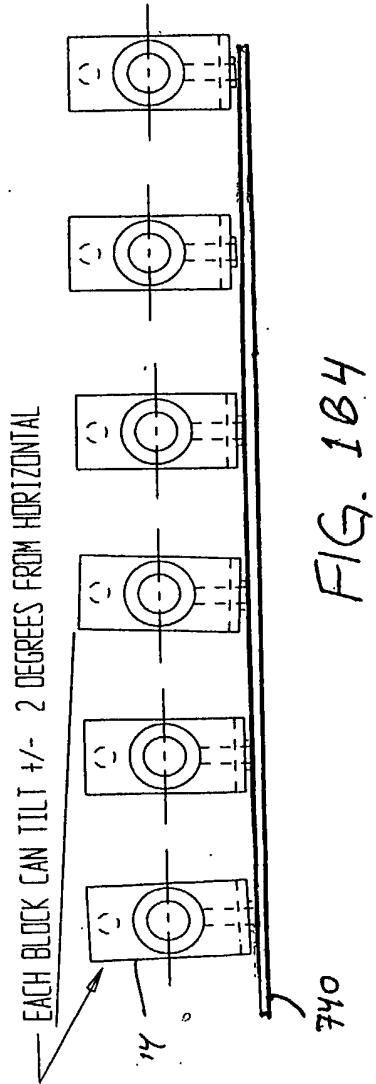
FIG 1B1

Magnified field of view of
CCD sensor element on
object
width of projected
laser illumination
beam on
object

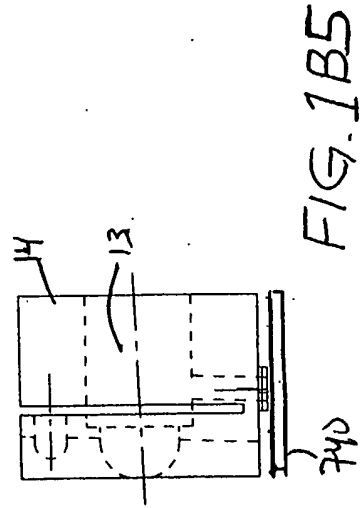
FIG 1B3

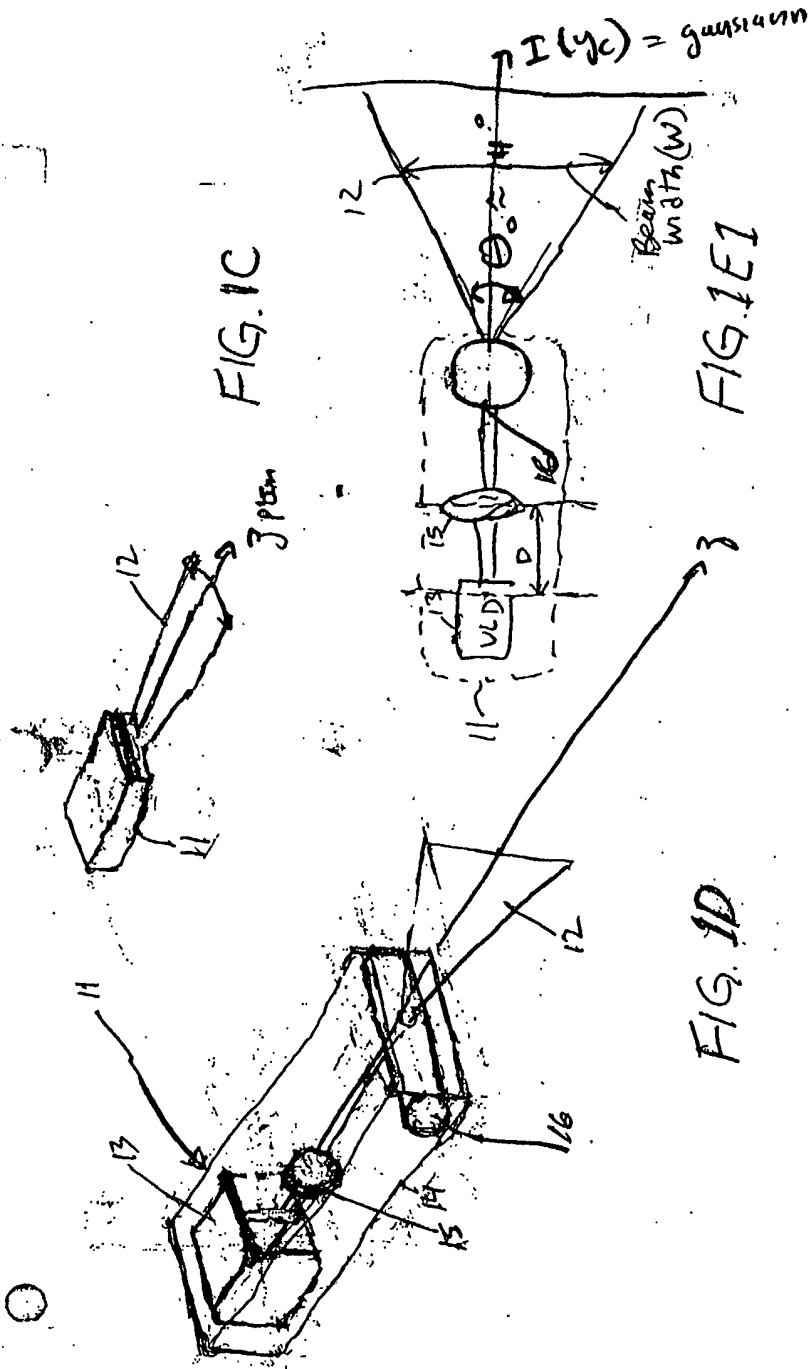


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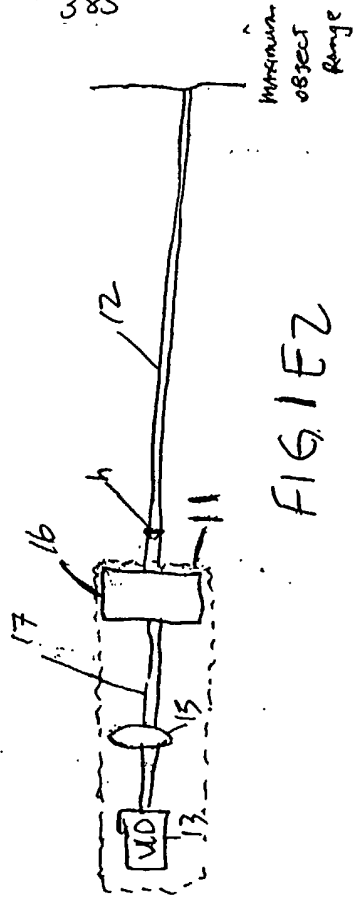


VLD BLOCK CAN PITCH FORWARD FOR ALIGNMENT WITH OTHER VLD BEAMS





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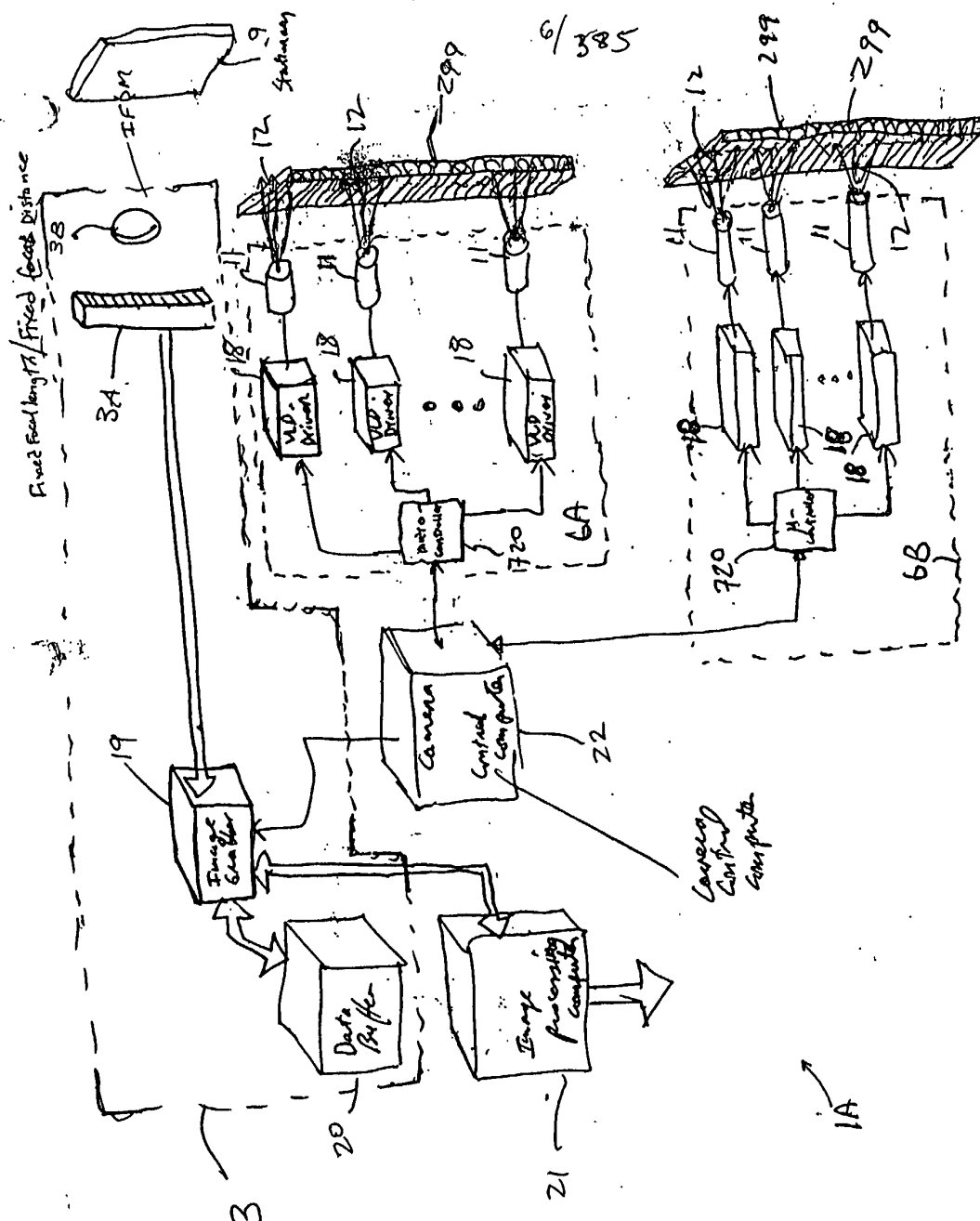


FIG. 1F

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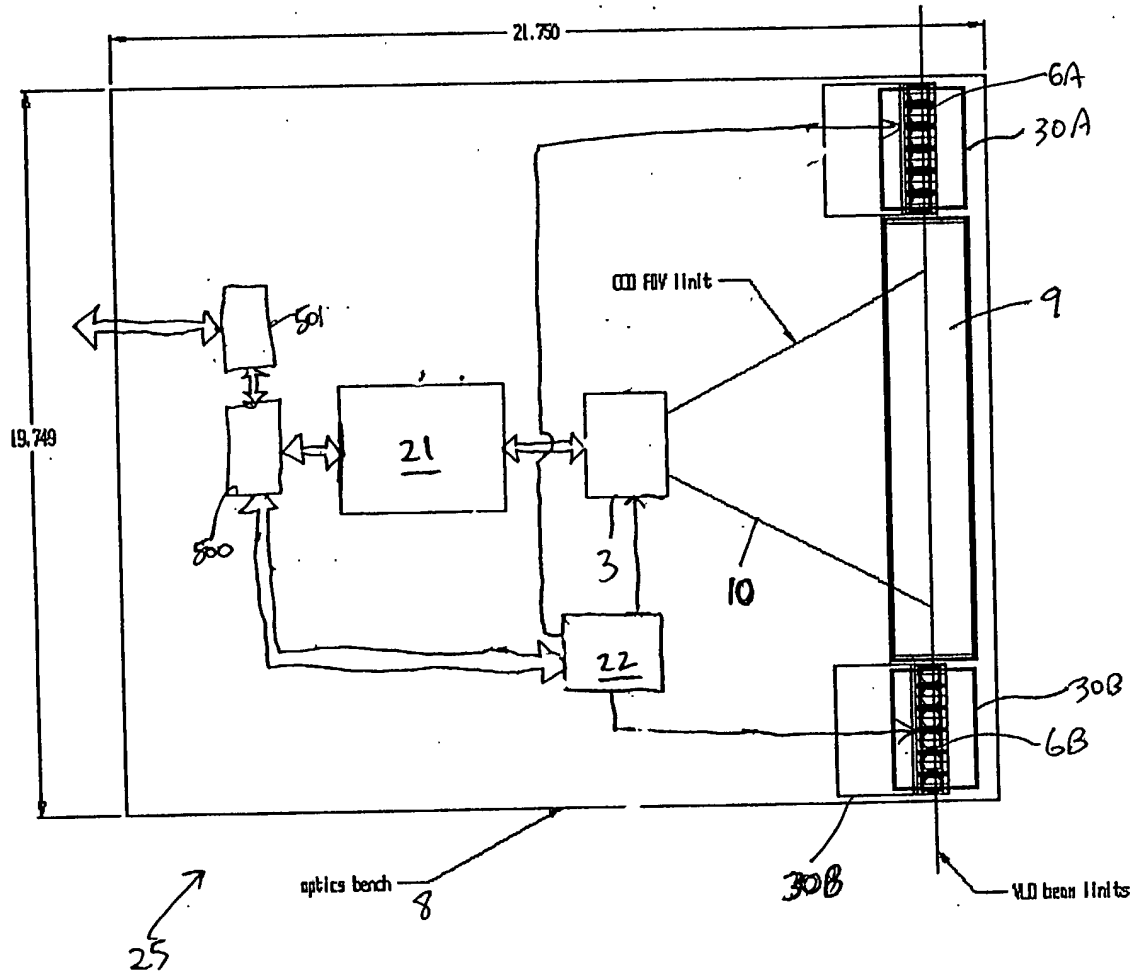
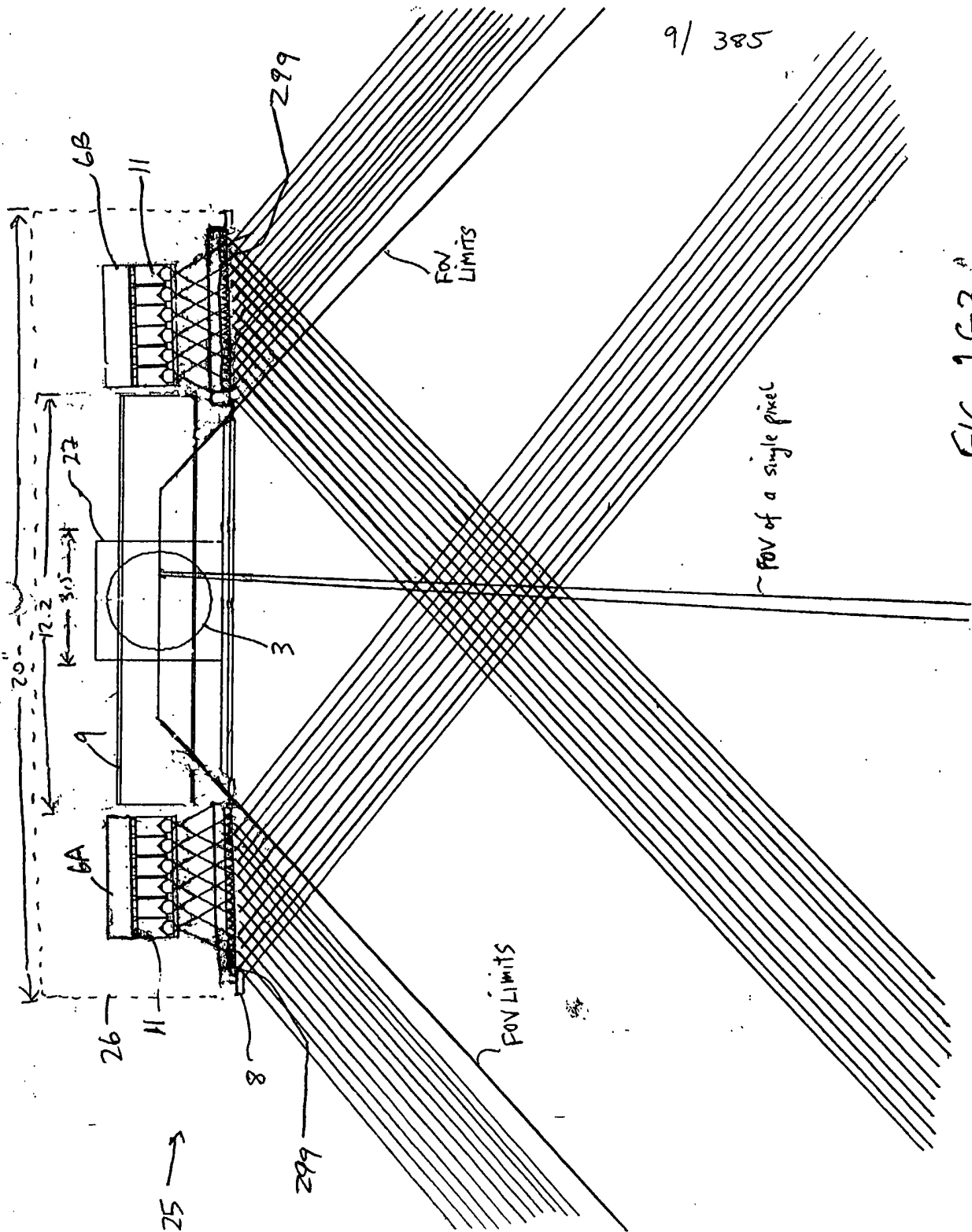


FIG. 162



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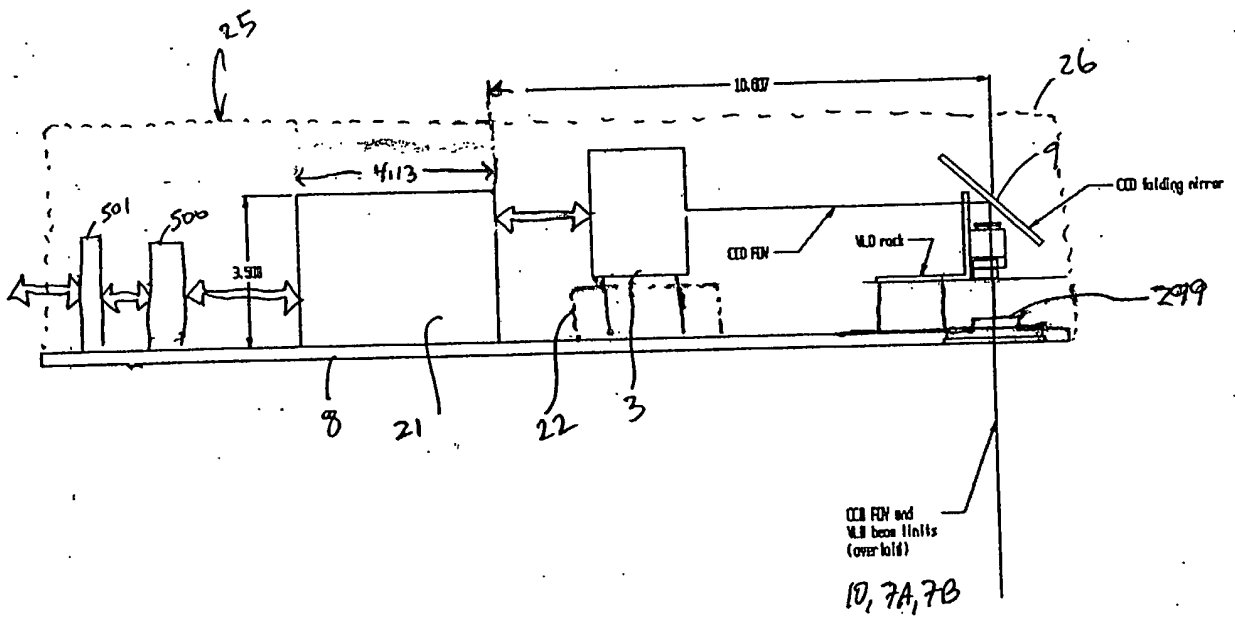
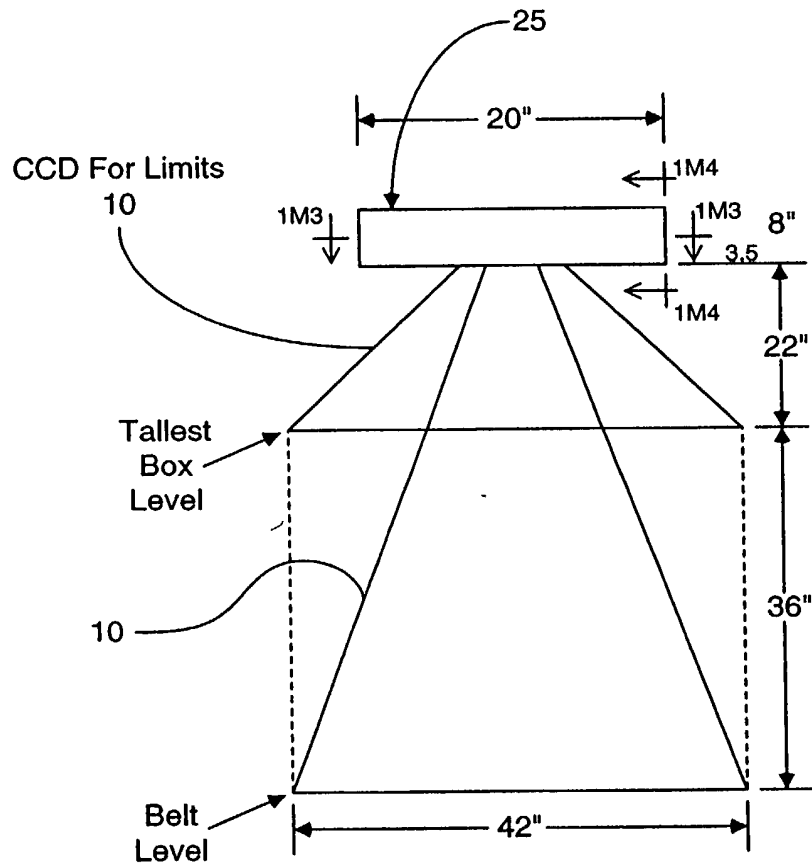


FIG. 164

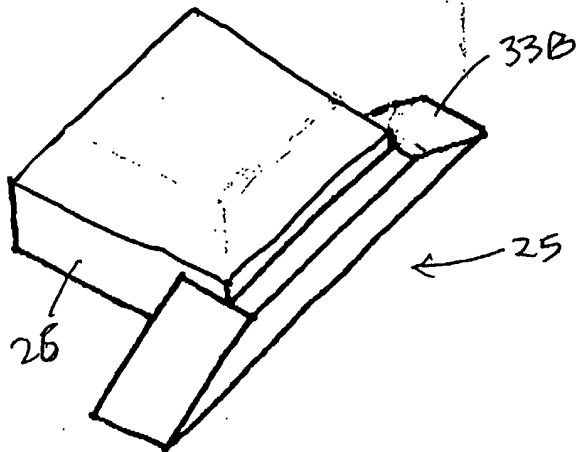
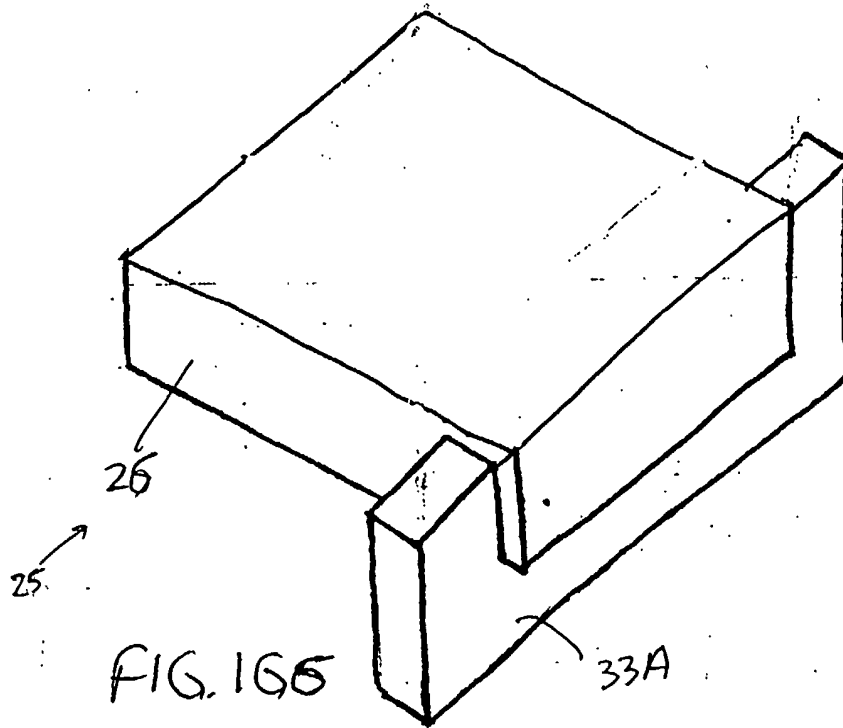
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* Fixed Field Of Field

FIG. 1G5

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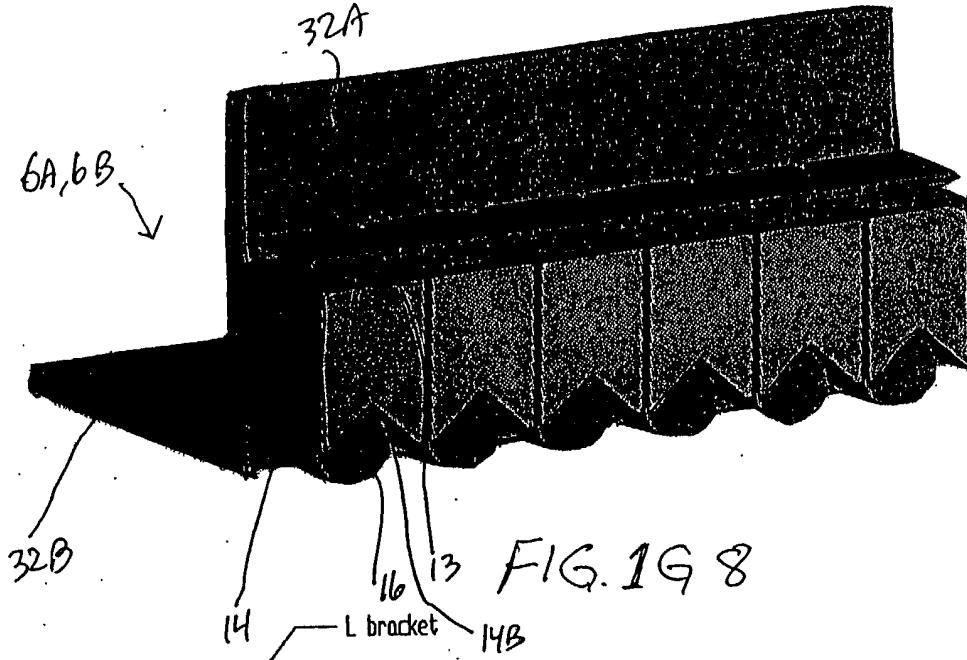


FIG. 1G 8

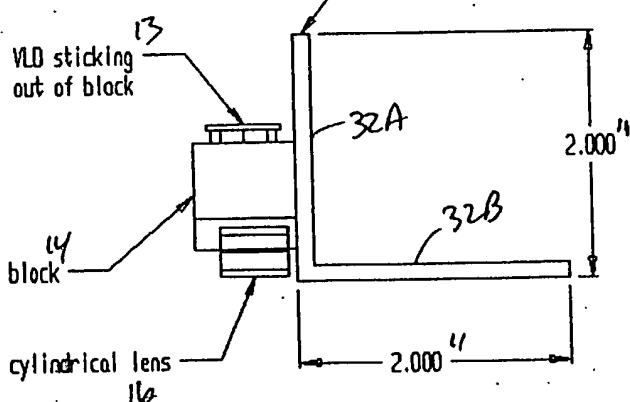


FIG. 1G 9

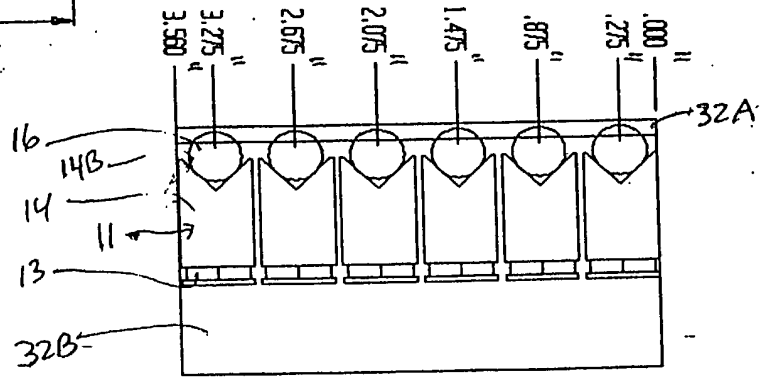


FIG. 1G 10

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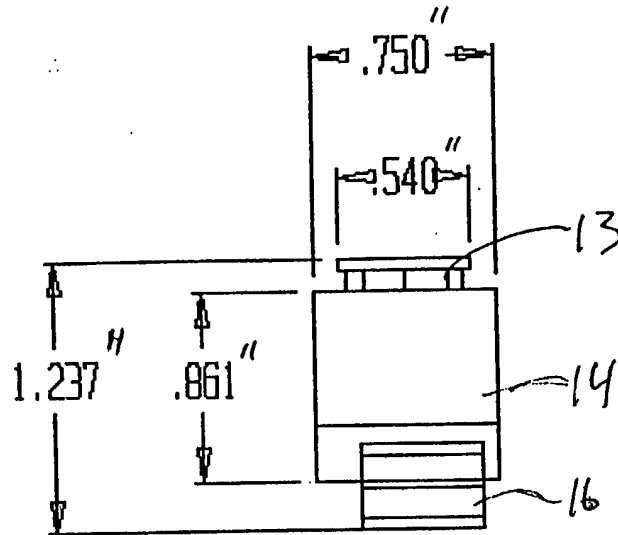


FIG. 1611

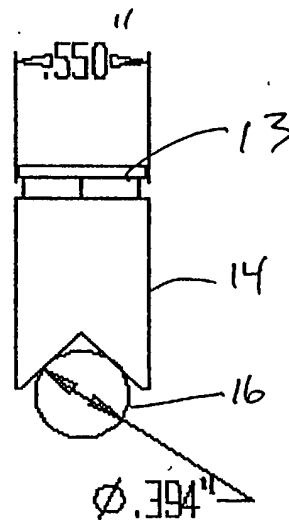


FIG. 1612

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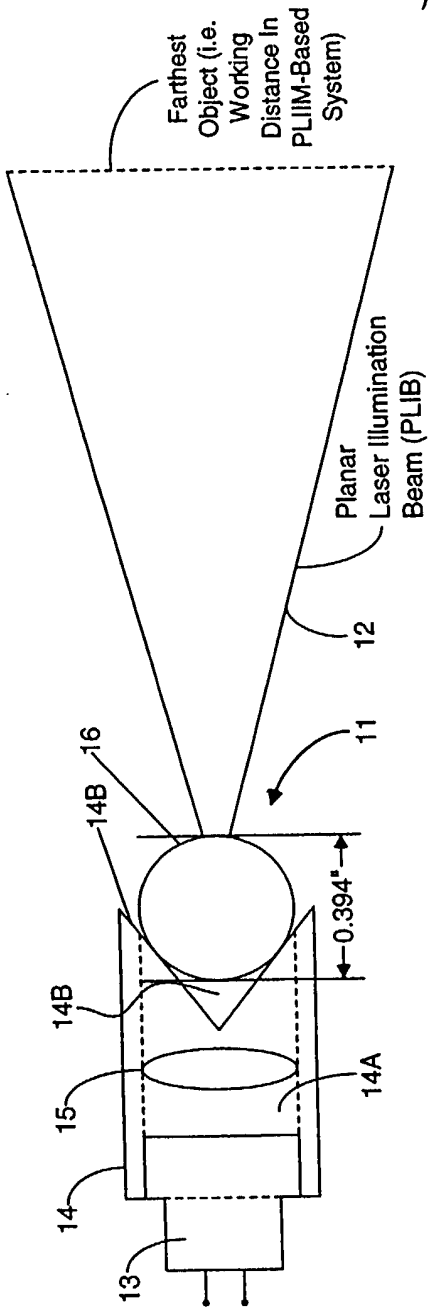


FIG. 1G15A

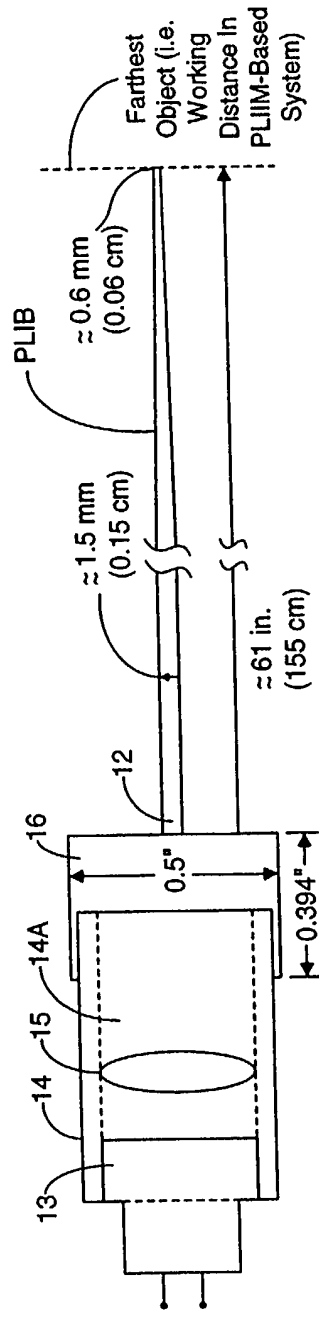


FIG. 1G15B

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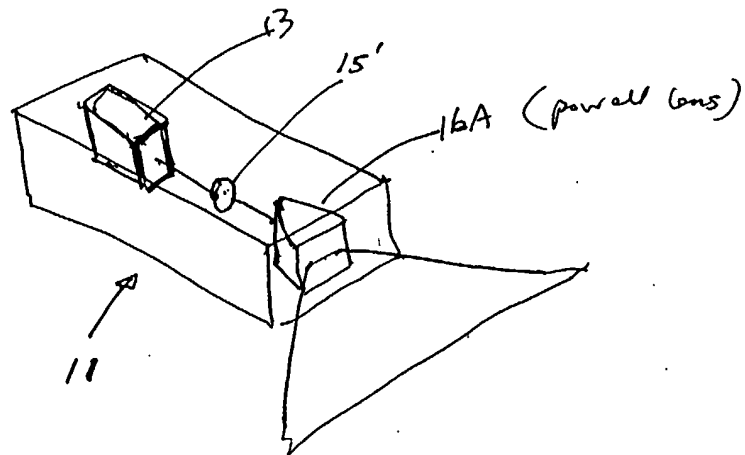


FIG. 1G.16A

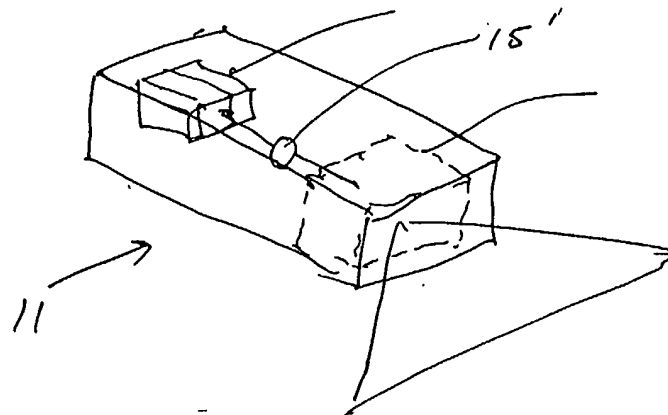


FIG. 1G.16B

• PLIM w/
power lens

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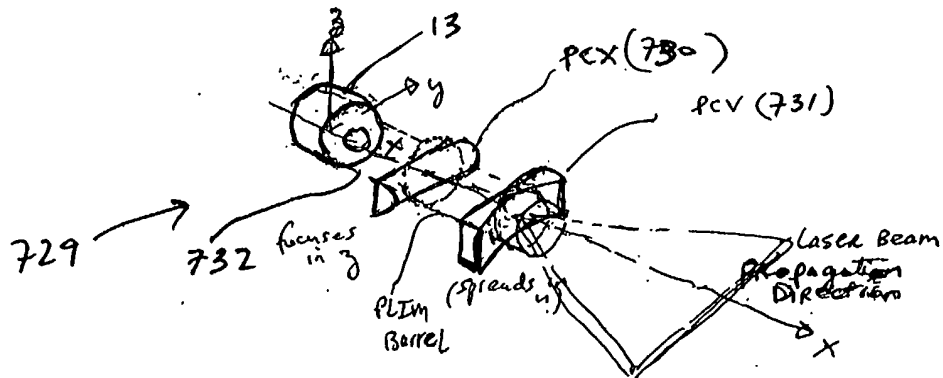


FIG. 16.17A

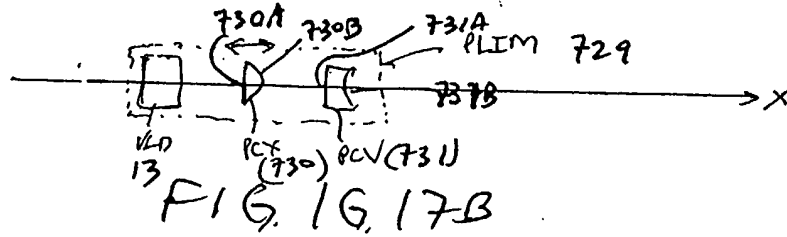


FIG. 16.17B

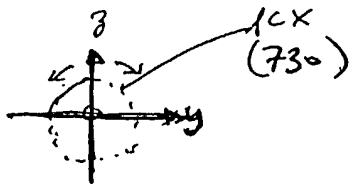


FIG. 16.17C

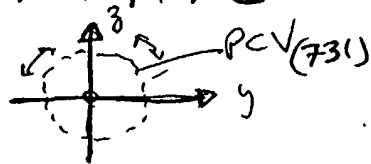


FIG. 16.17D

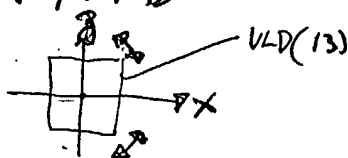


FIG. 16.17E

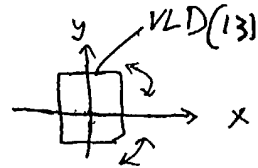


FIG. 16.17F

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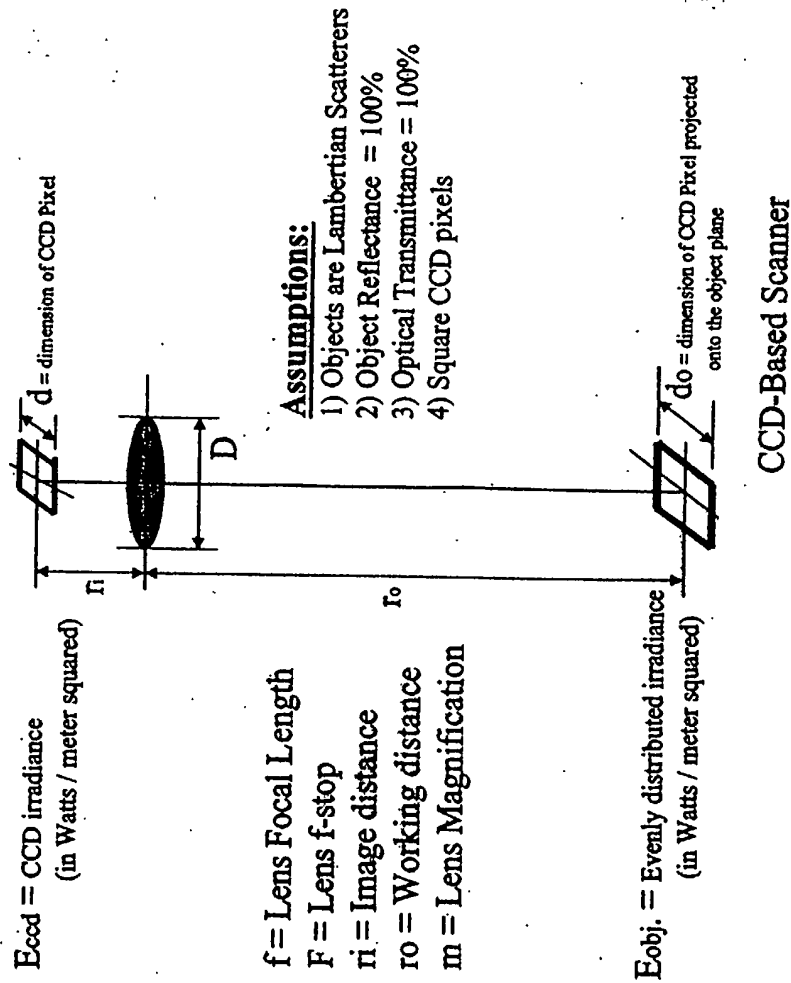


FIG. 1H6

FIRST GENERALIZED METHOD
of Reducing Speckle-Noise
PATTERNS AT IMAGE
DETECTION array OF THE
SPM SYSTEM (3)

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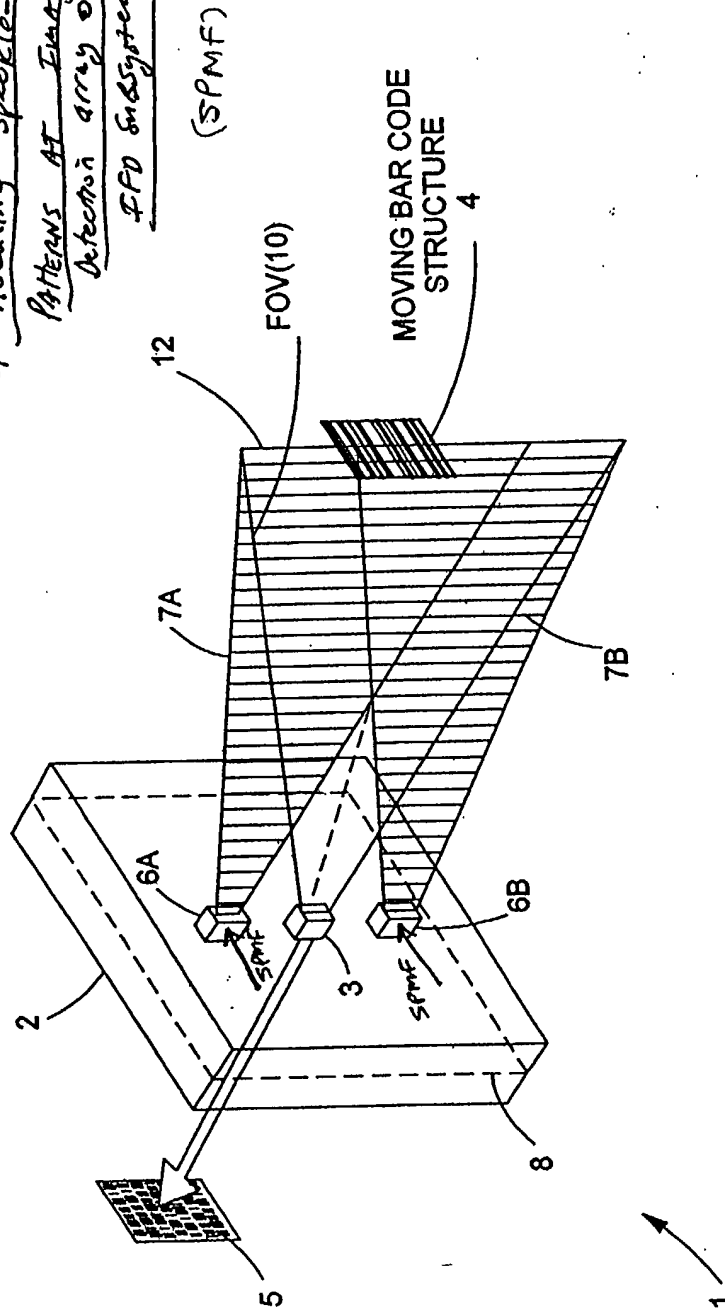
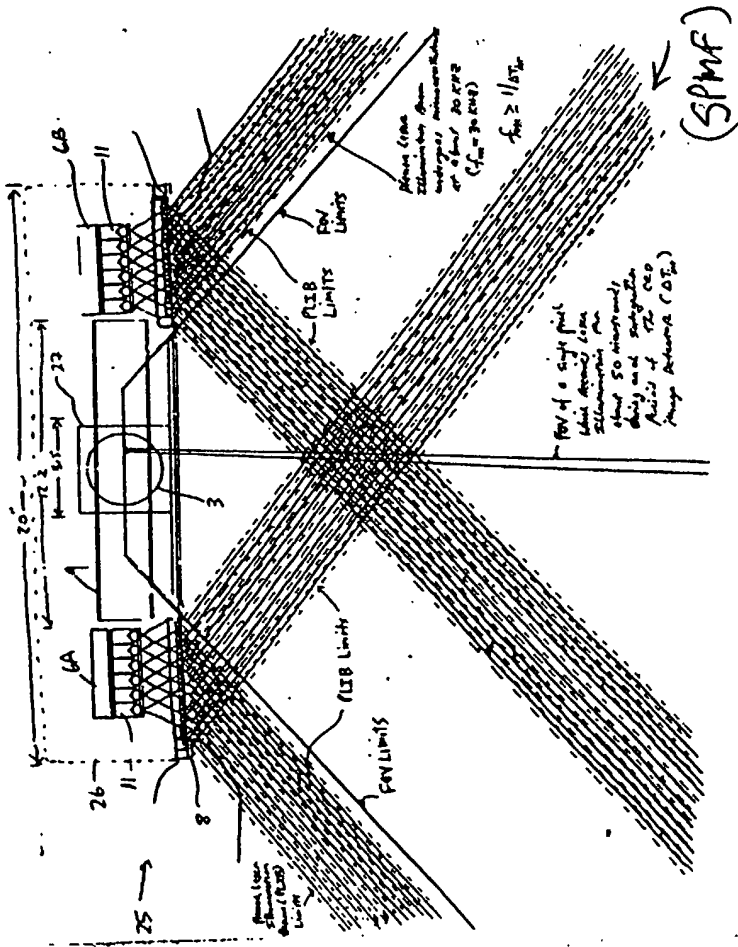


FIG. 1I1

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Prior to object illumination

FIG. 1I2A

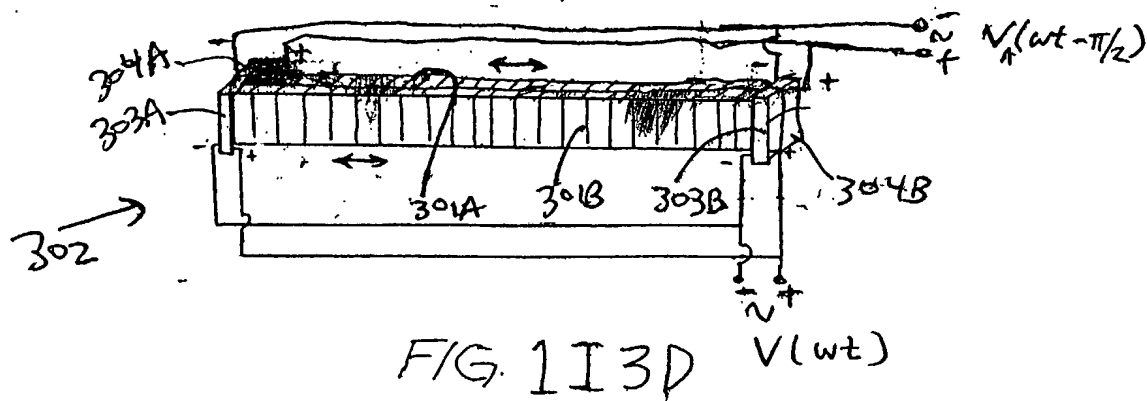
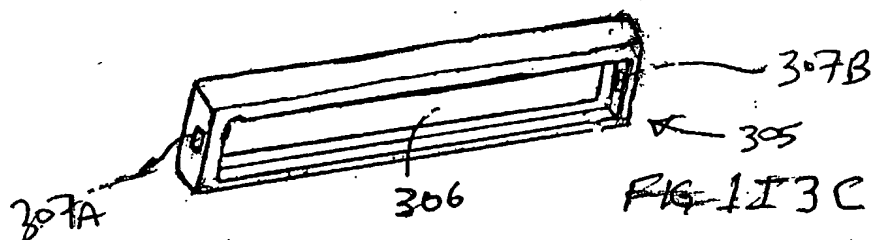
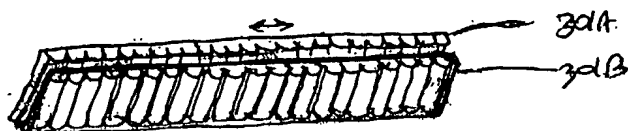
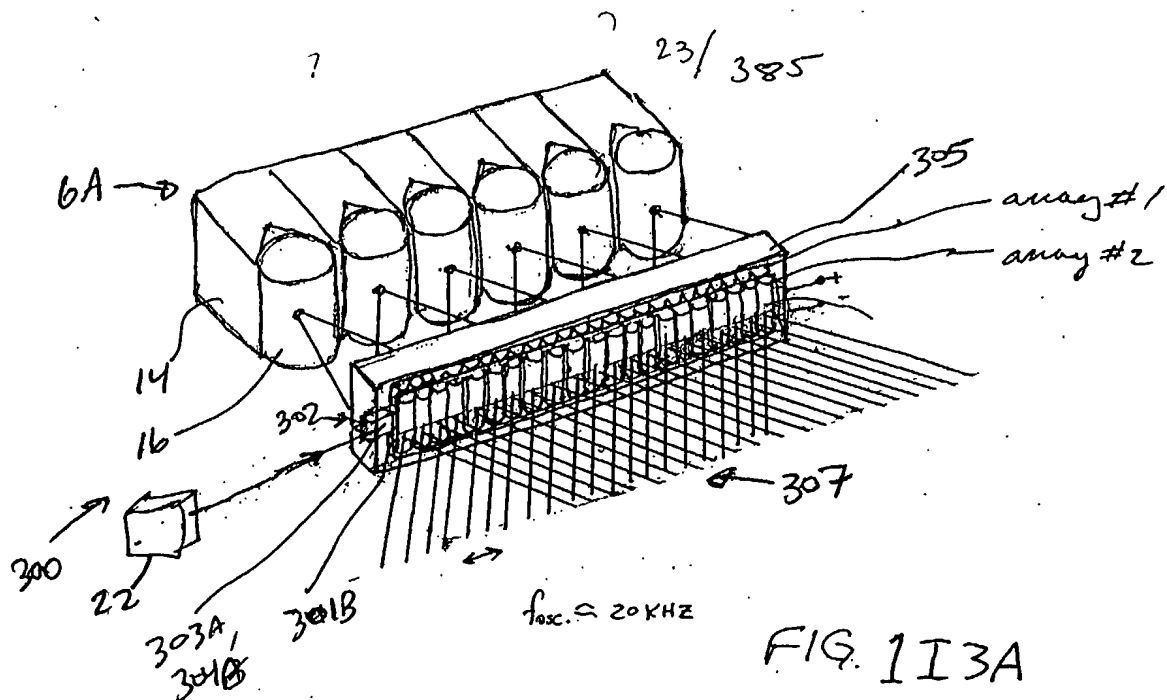
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**The First Generalized Speckle-Noise Pattern Reduction Method
Of The Present Invention**

Prior to illumination of the target with the planar laser illumination beam (PLIB), modulate the spatial phase of the transmitted PLIB along the planar extent thereof according to a spatial phase modulation function (SPMF) so as to produce numerous substantially different time-varying speckle-noise patterns at the image detection array of the IFD Subsystem during the photo-integration time period thereof.

Temporally average the numerous substantially different time-varying speckle-noise patterns produced at the image detection array in the IFD Subsystem during the photo-integration time period thereof, so as to thereby reduce the power of the speckle-noise pattern observed at the image detection array.

FIG. 1I2B



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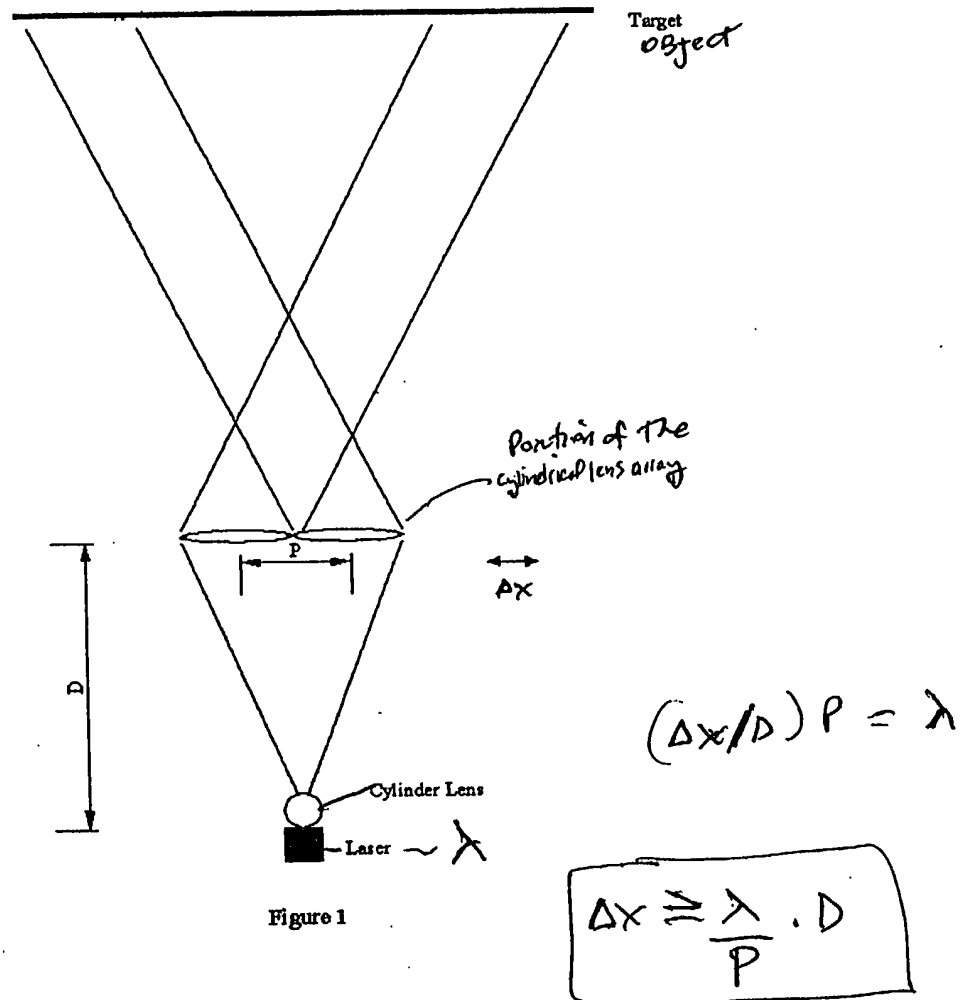


FIG. 1I3E

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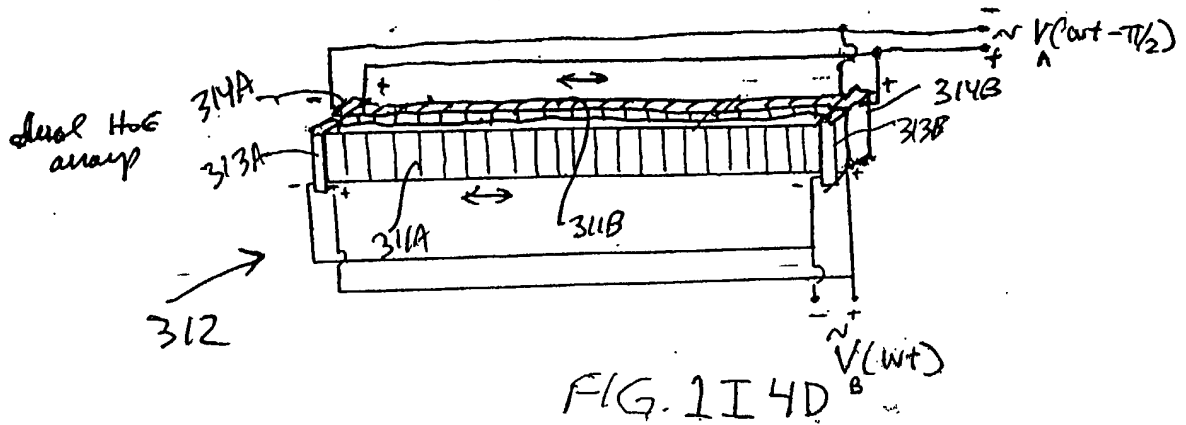
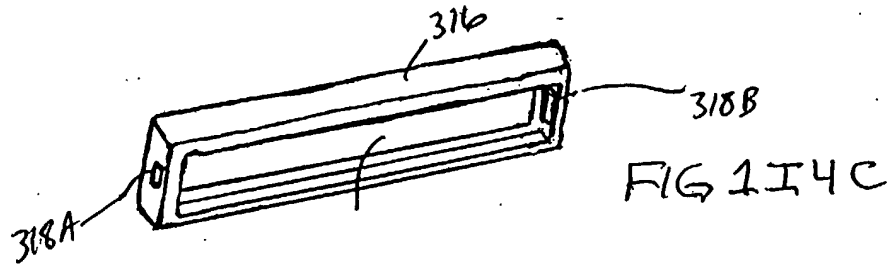
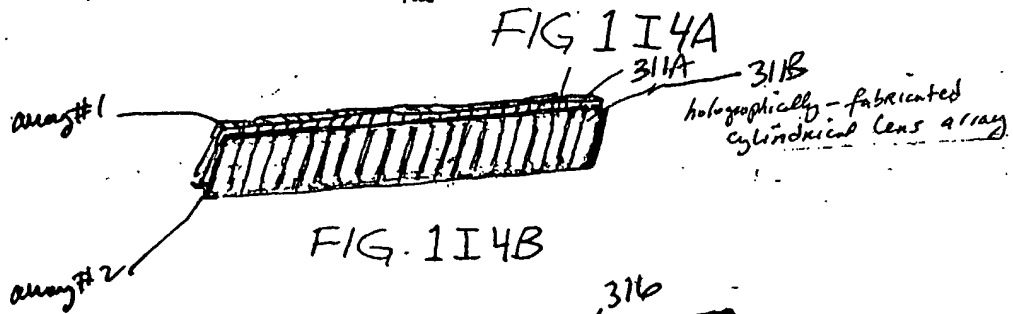
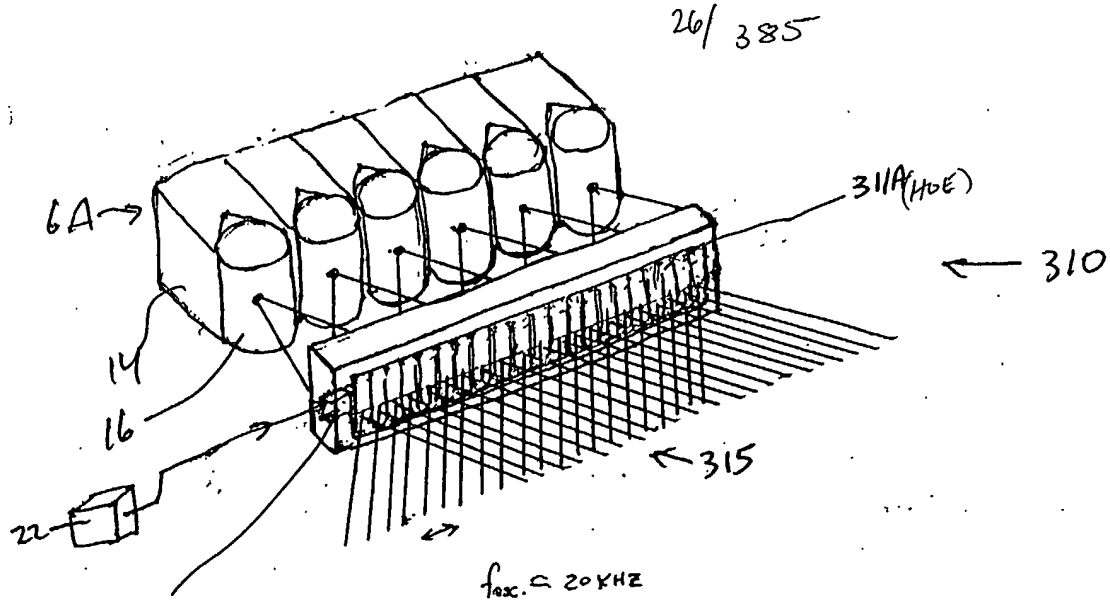


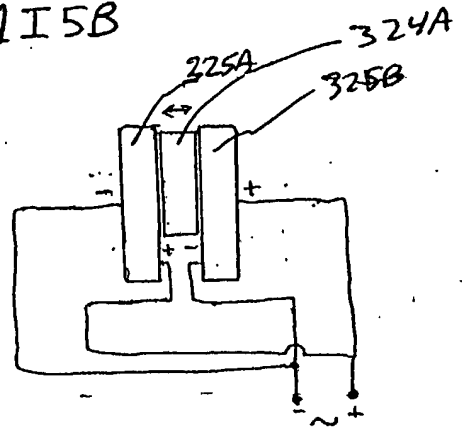
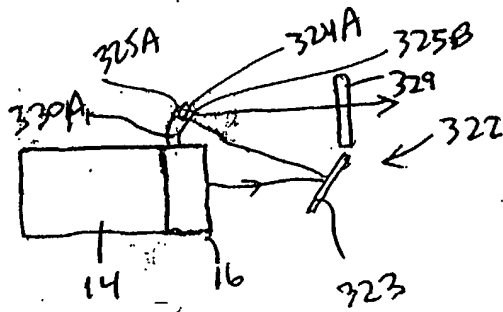
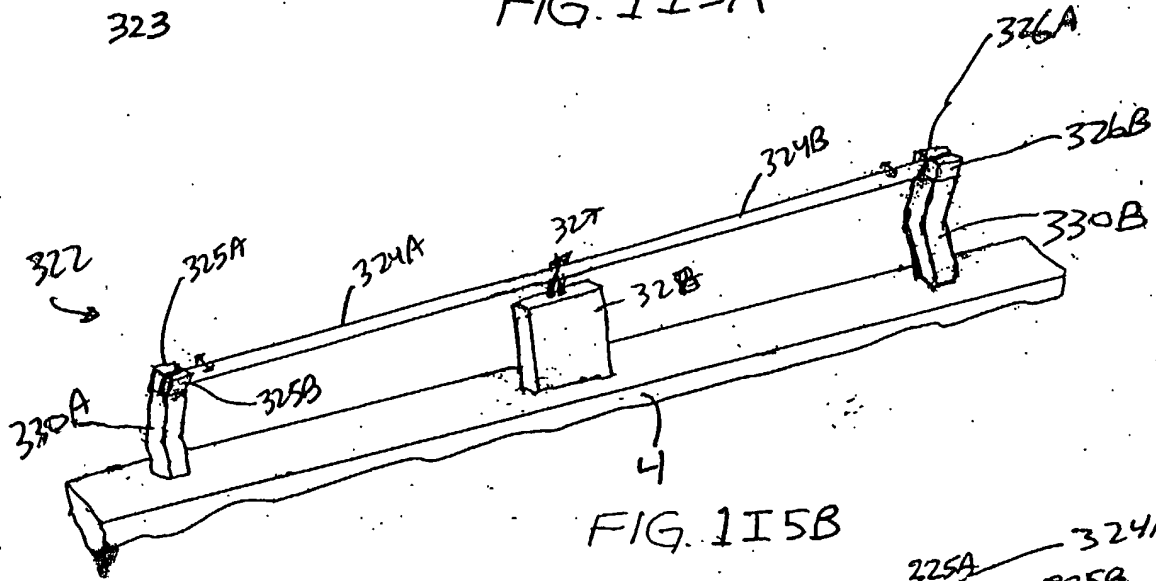
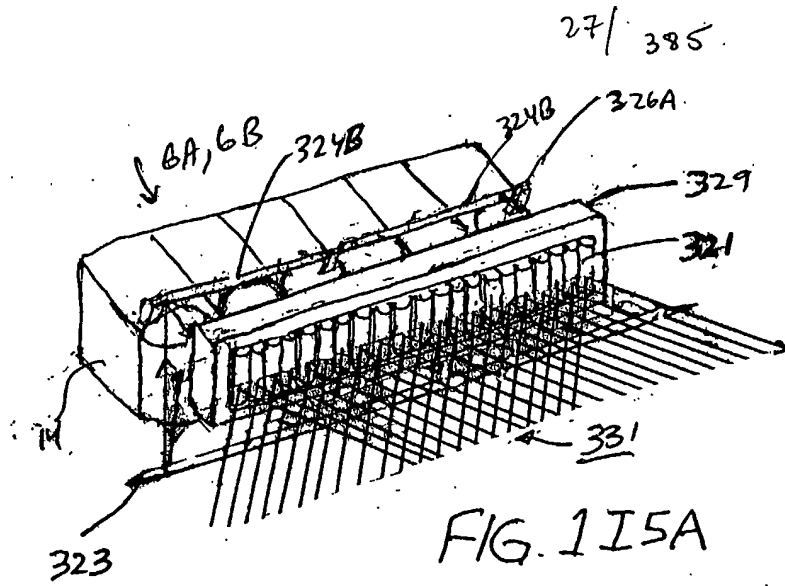
FIG. 1I3F

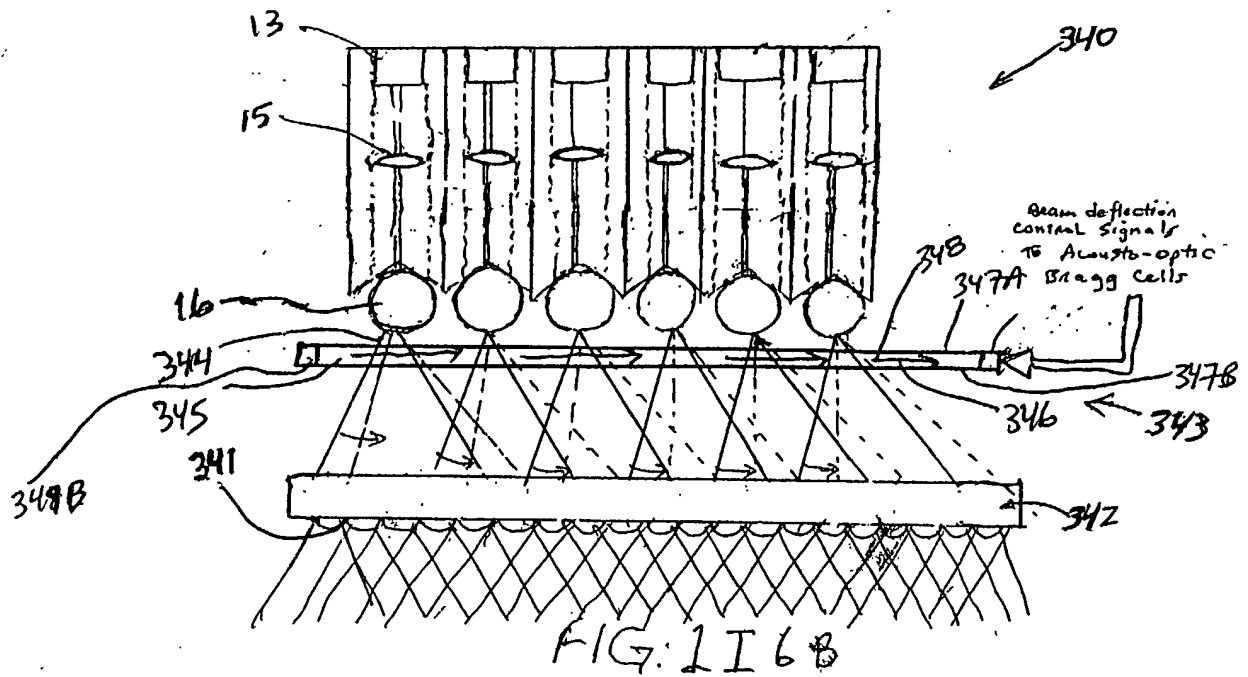
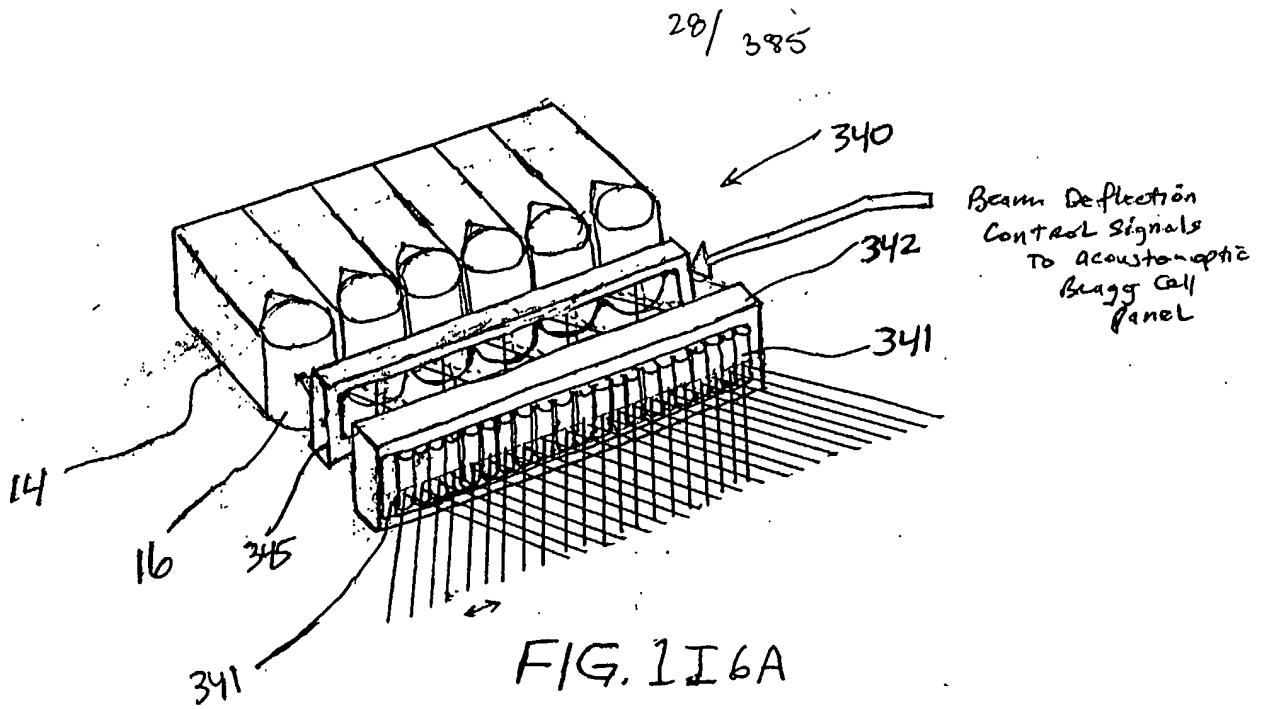


FIG 1I3G

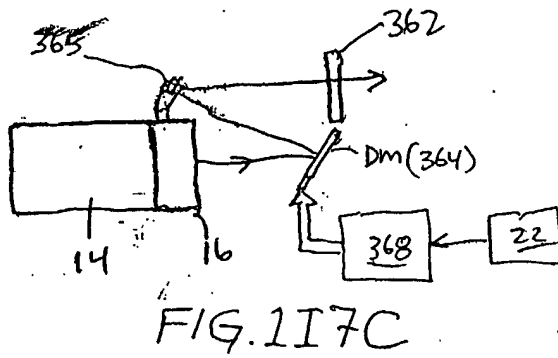
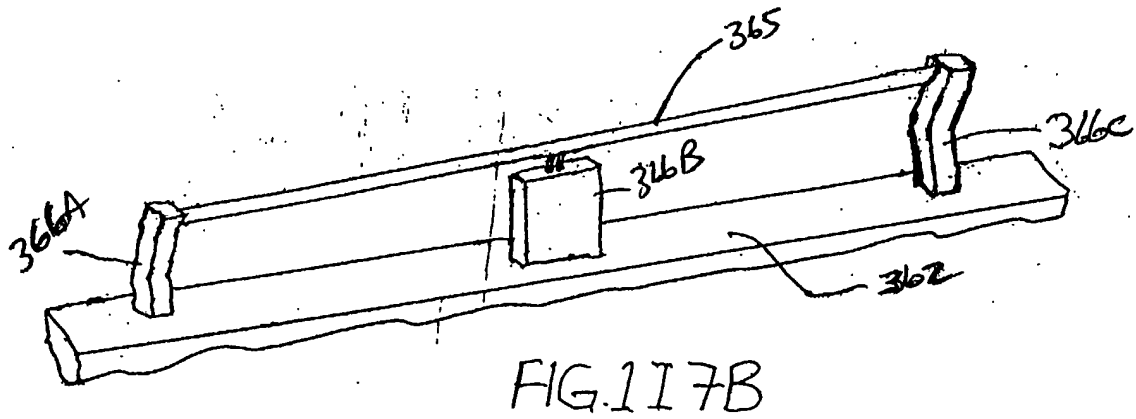
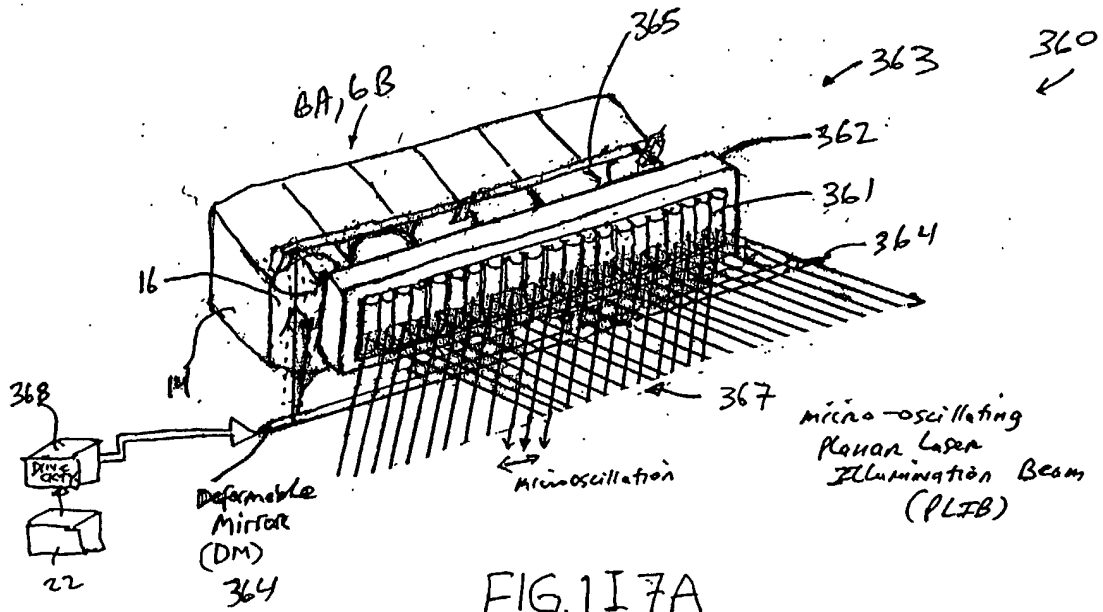


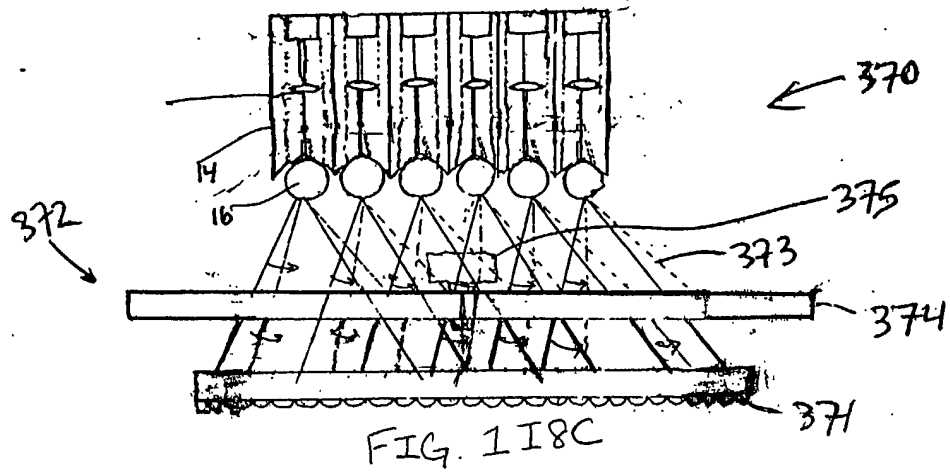
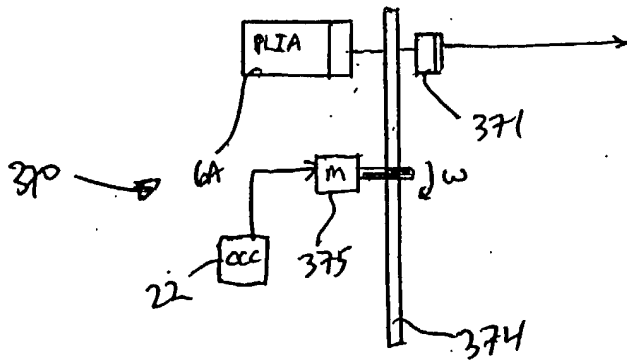
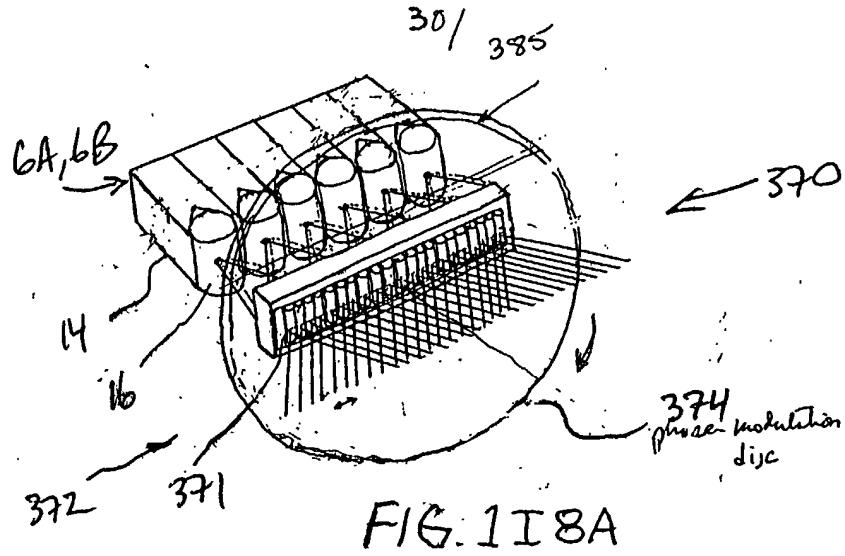




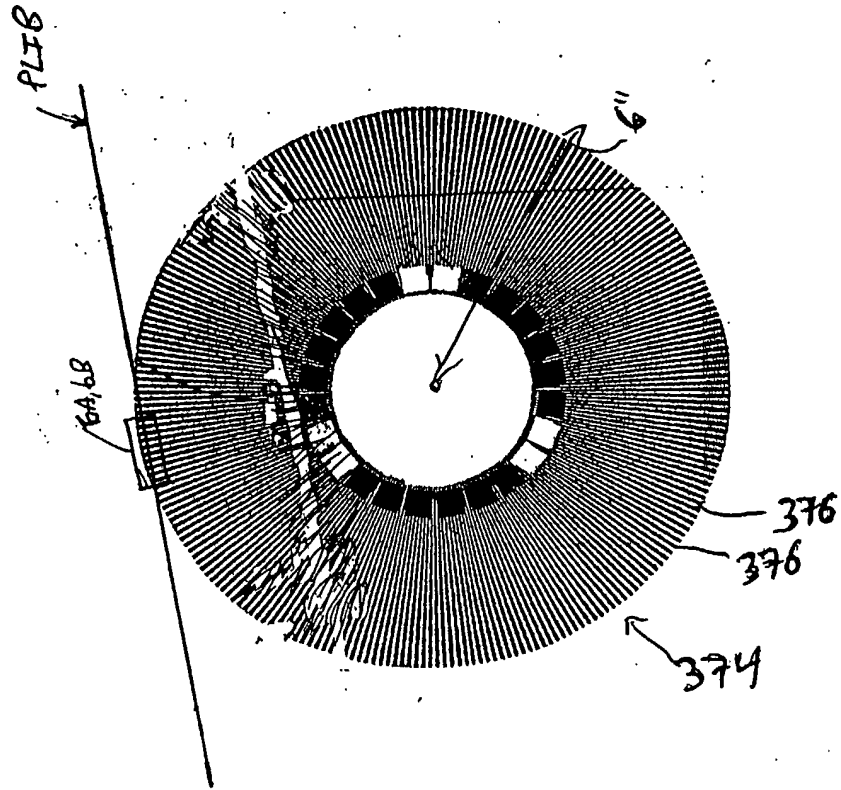
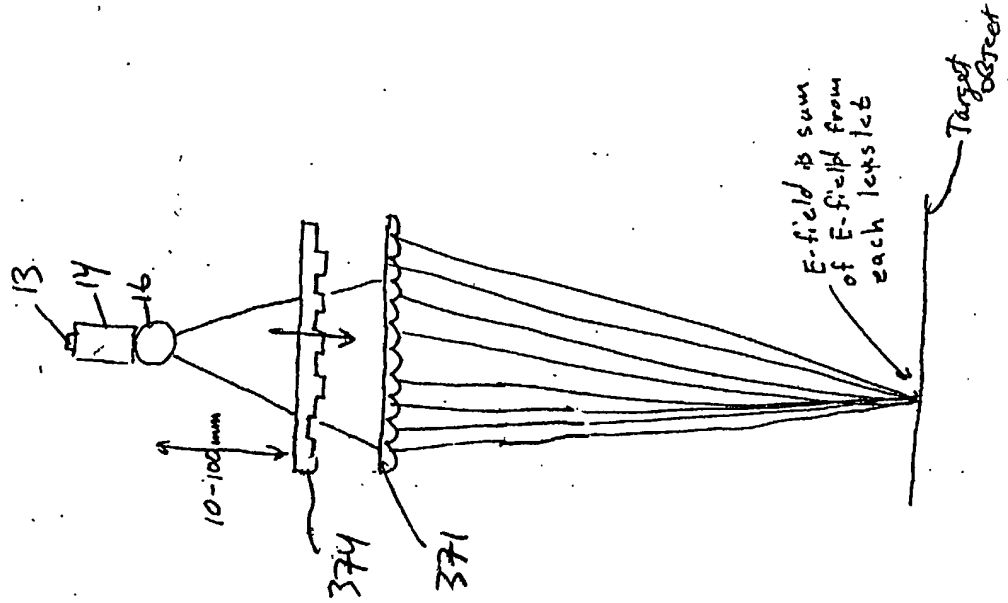


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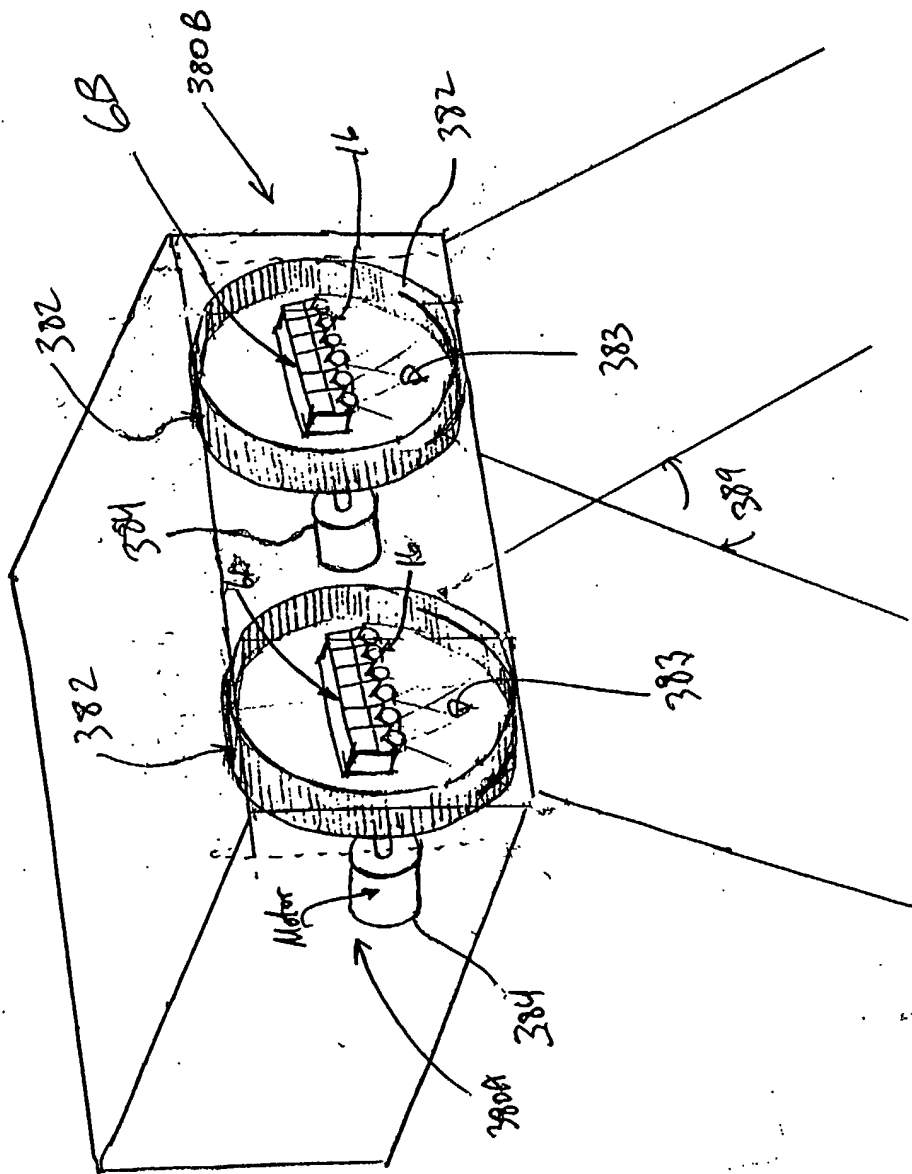




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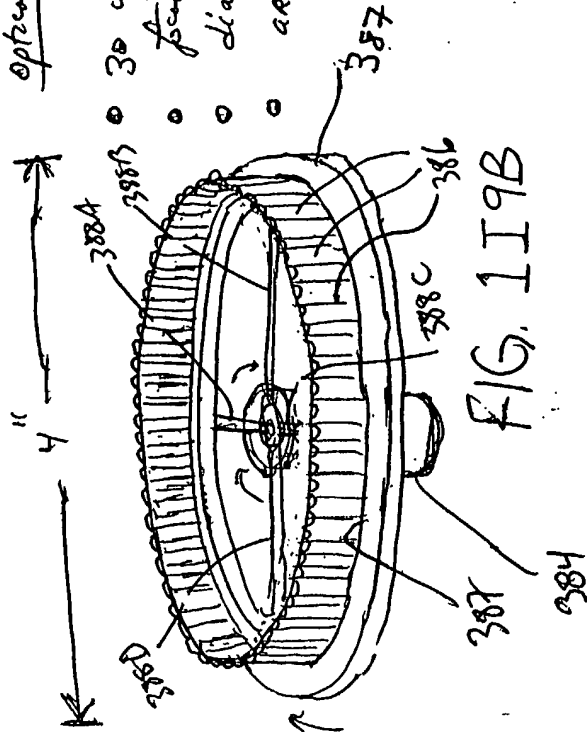
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3A/ 385

Optical specifications:

- 30 cylindrical lens (lenses) per linear inch
- focal length: 2.0 millimeters
- diameter of lenslet carousel ≈ 4 inches
- acrylic material



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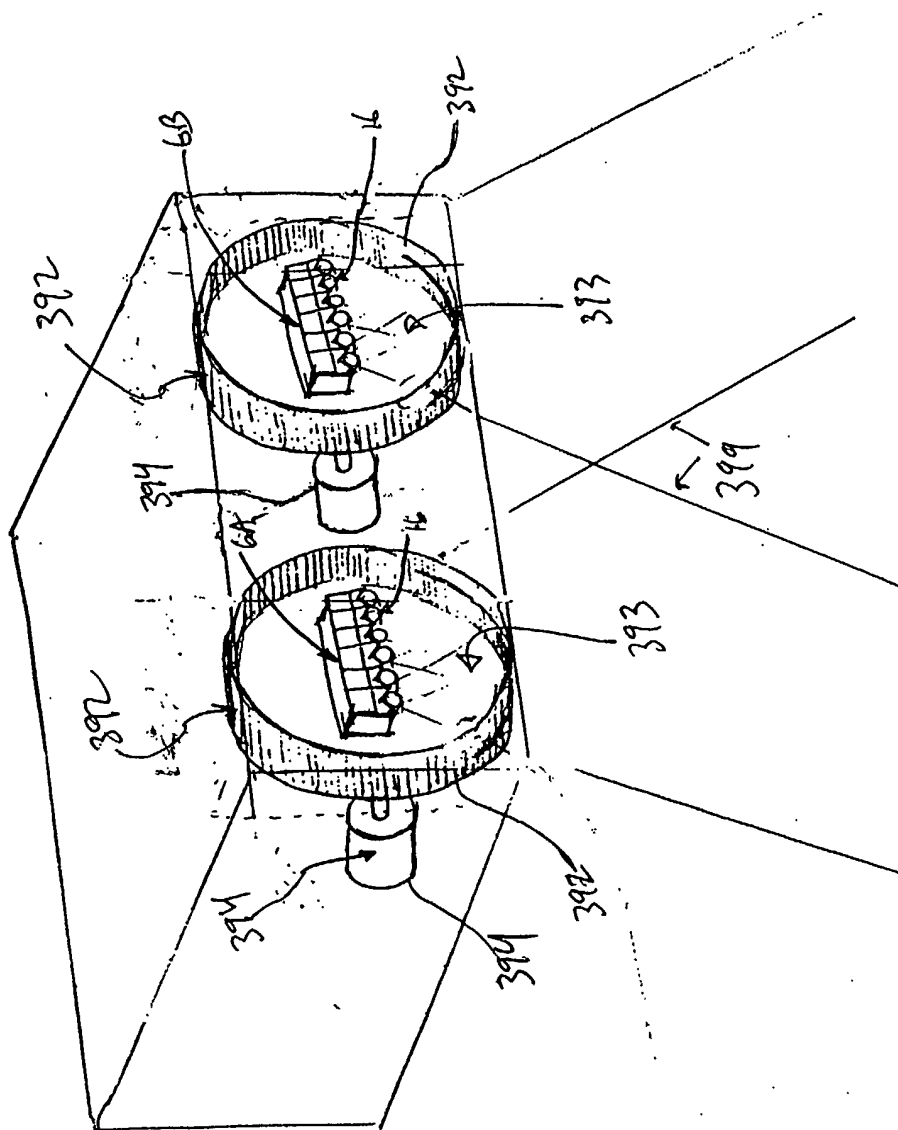


FIG. 1110A

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Optical Specifications:

- 30 cylindrical lens (lines) per linear inch
- focal length: 2.0 millimeters
- diameter of lens: $\approx 1/4$ inches

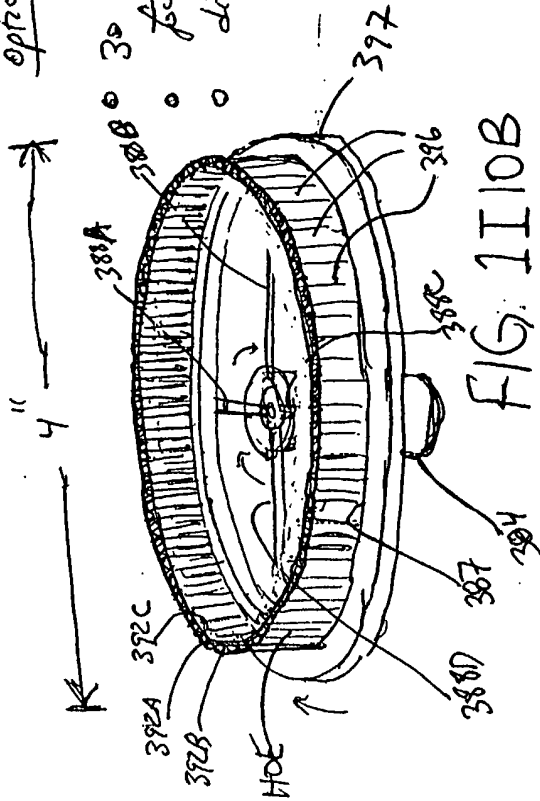


FIG. 1110B

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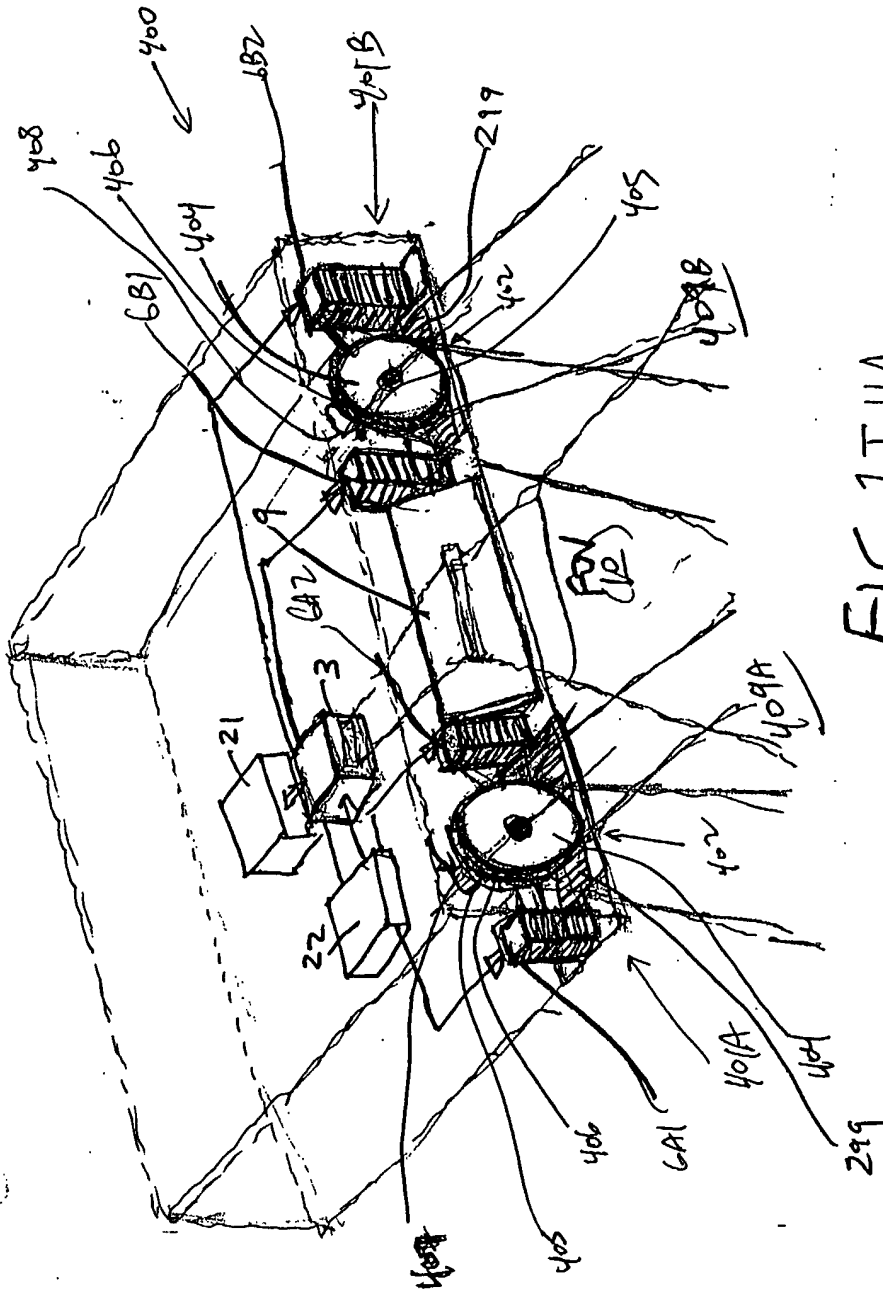


FIG. 11A

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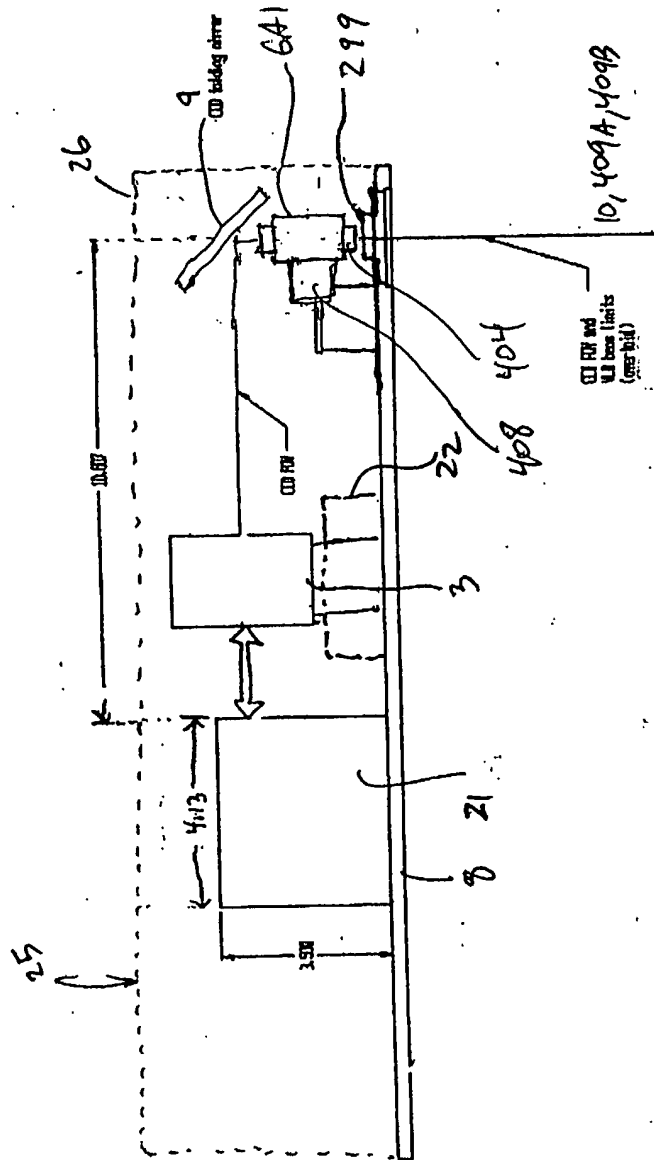


FIG. 111B

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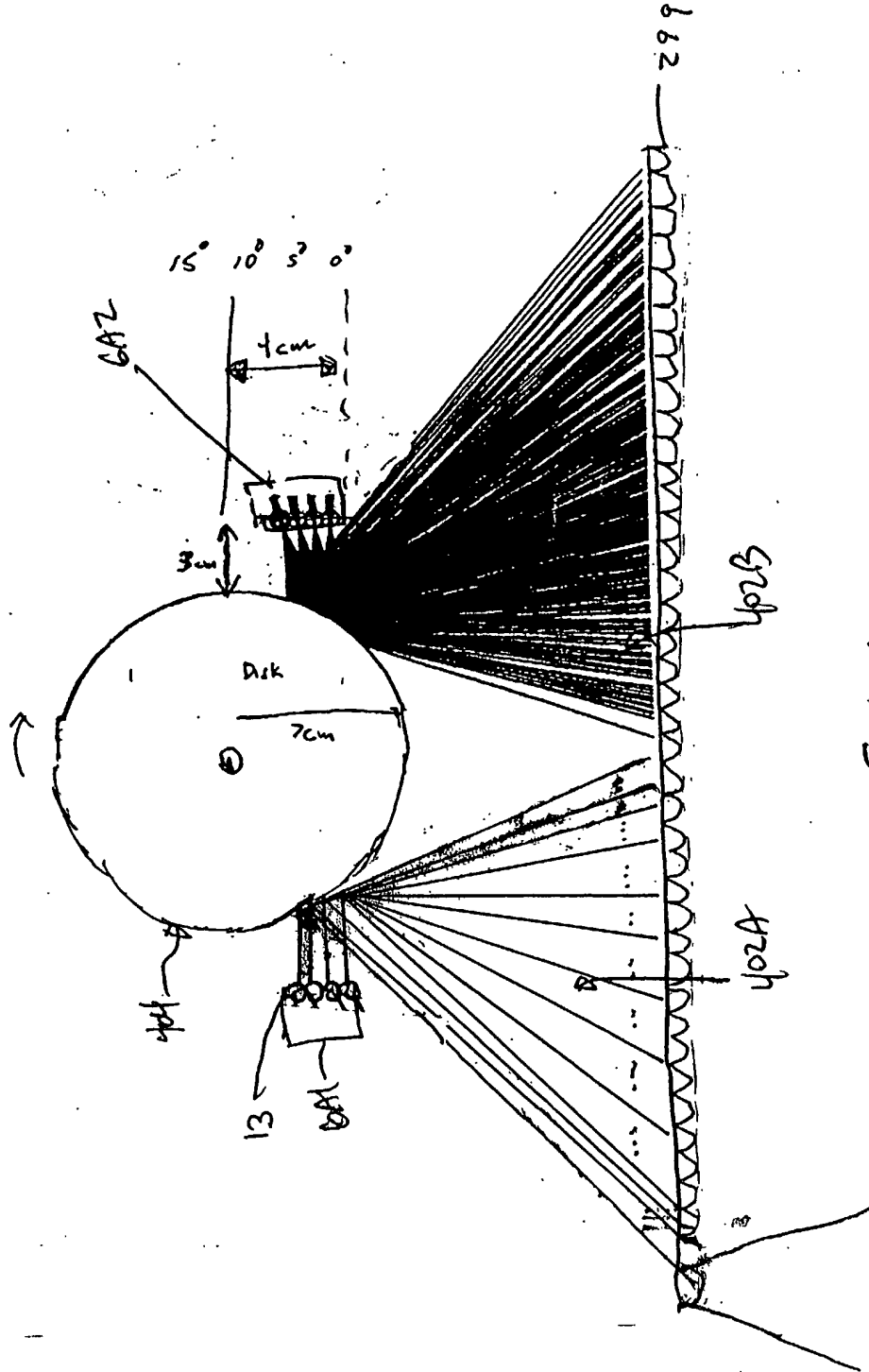


FIG. 1I11C

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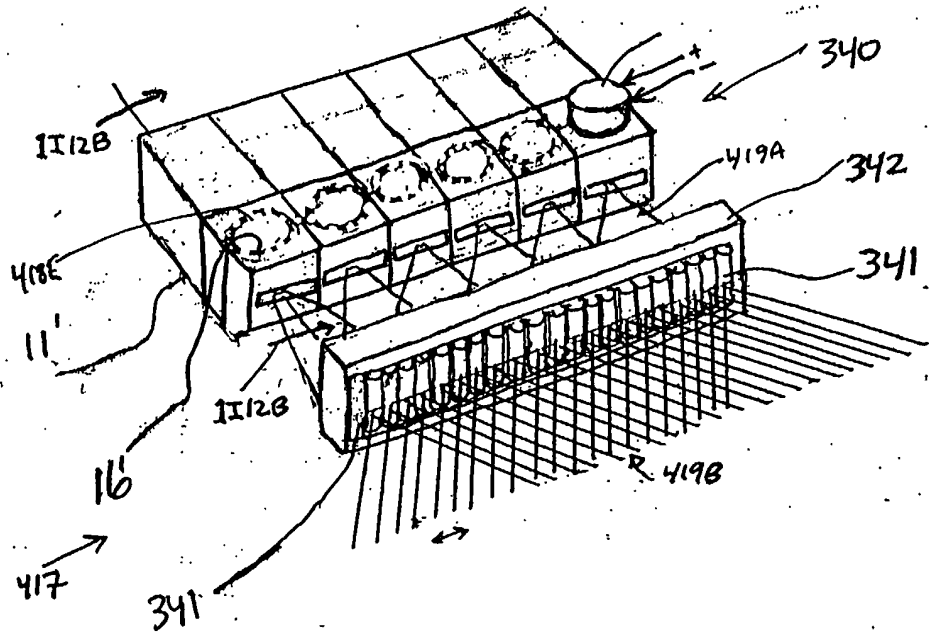


FIG. 1I12A

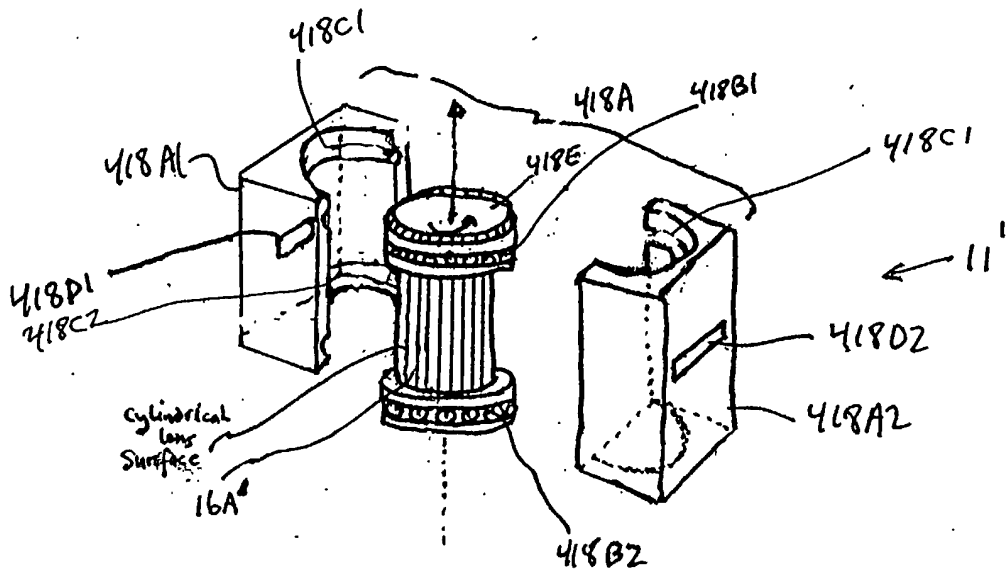


FIG. 1I12B

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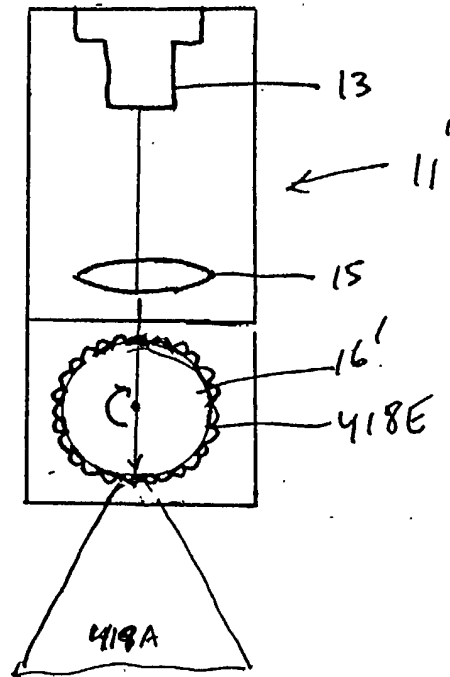


FIG. 1I12C

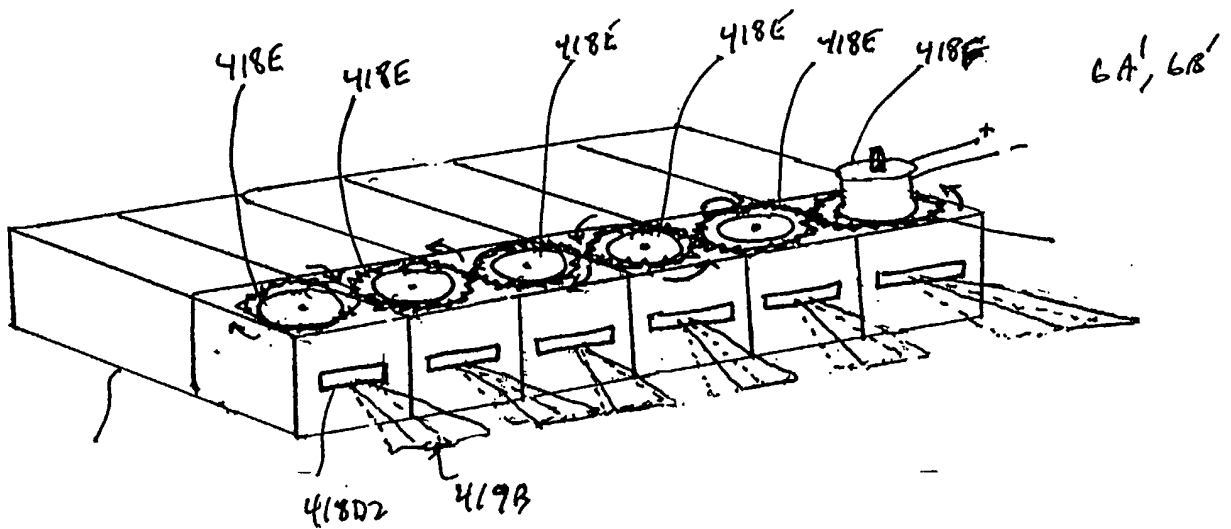


FIG. 1I12D

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Second Generalized Method of
Reducing Speckle-Noise Patterns
at Image Detection Array
of the FFD Subsystem (3)

(TIME)

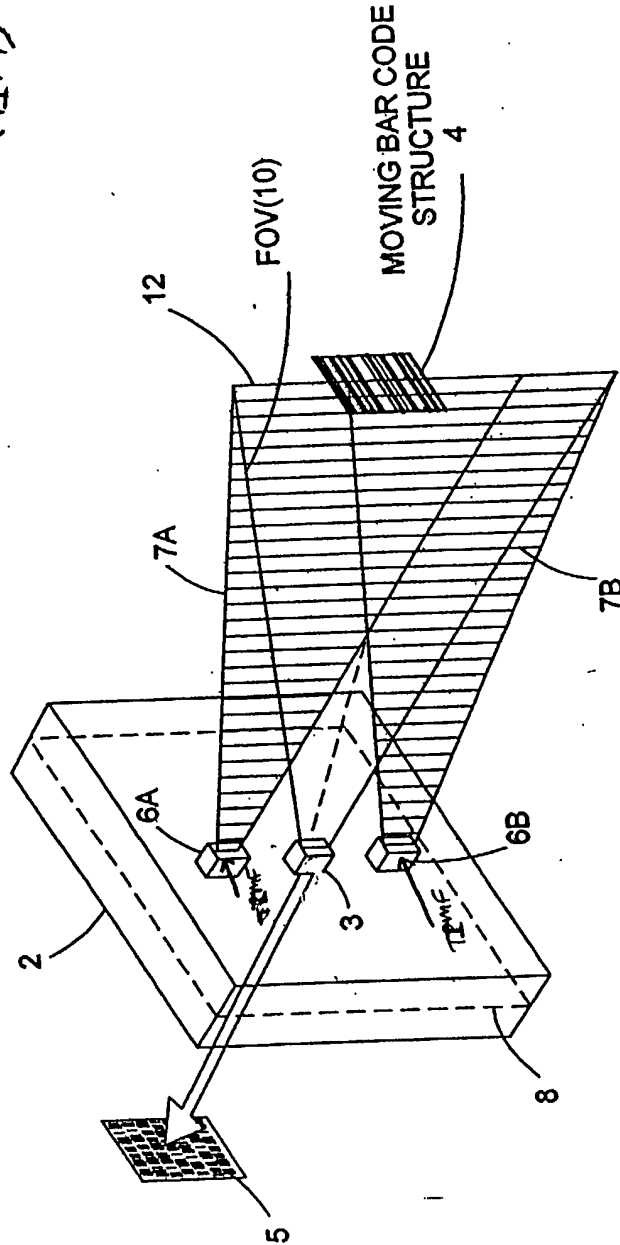


FIG. 1113

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The Second Generalized Speckle-Noise Pattern Reduction Method
Of The Present Invention

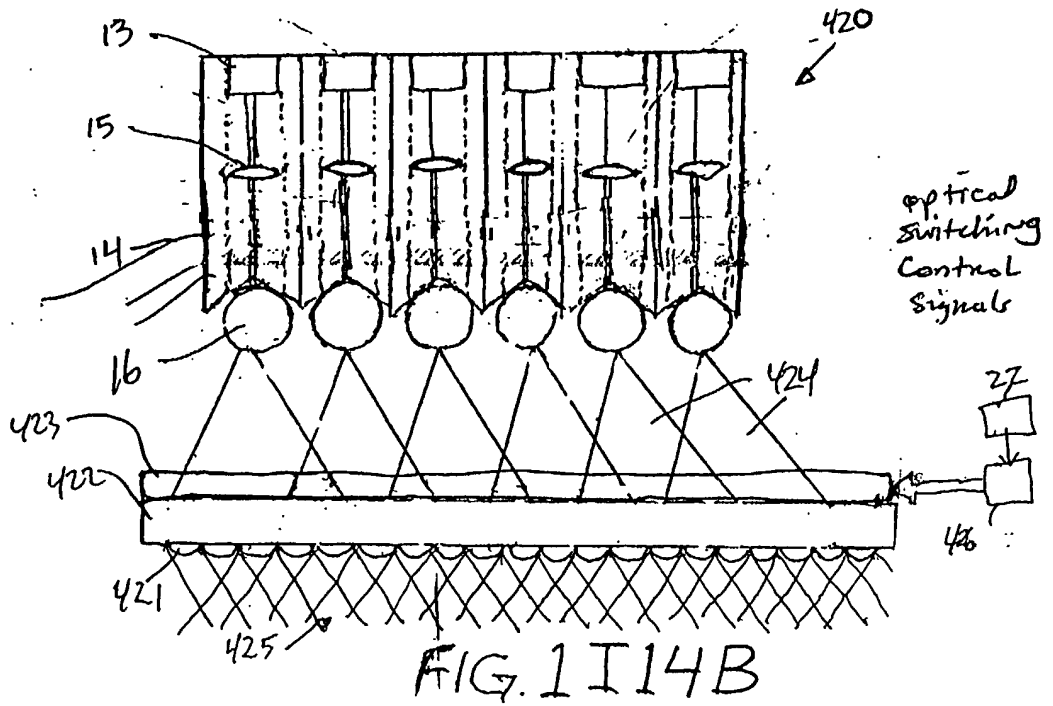
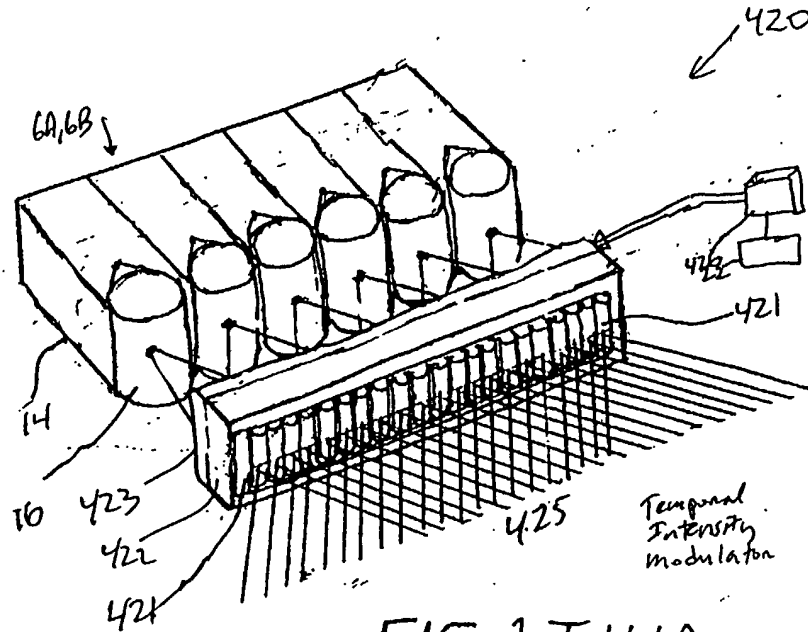
Prior to illumination of the target with the planar laser illumination beam (PLIB), modulate the temporal intensity of the transmitted PLIB along the planar extent thereof according to a temporal intensity modulation function (TIMF) so as to

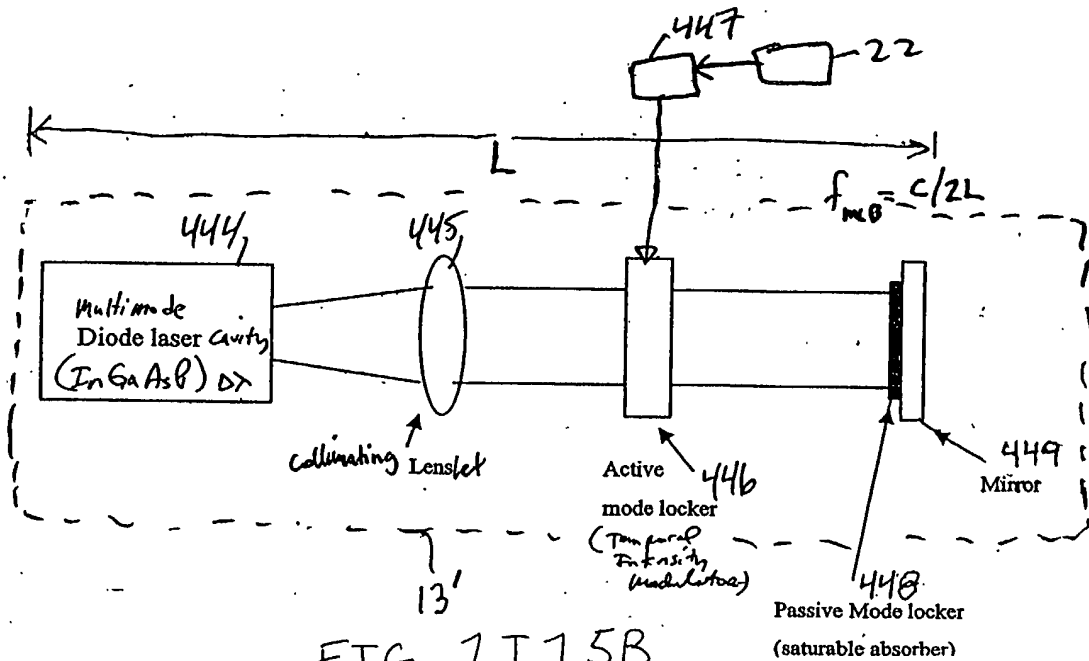
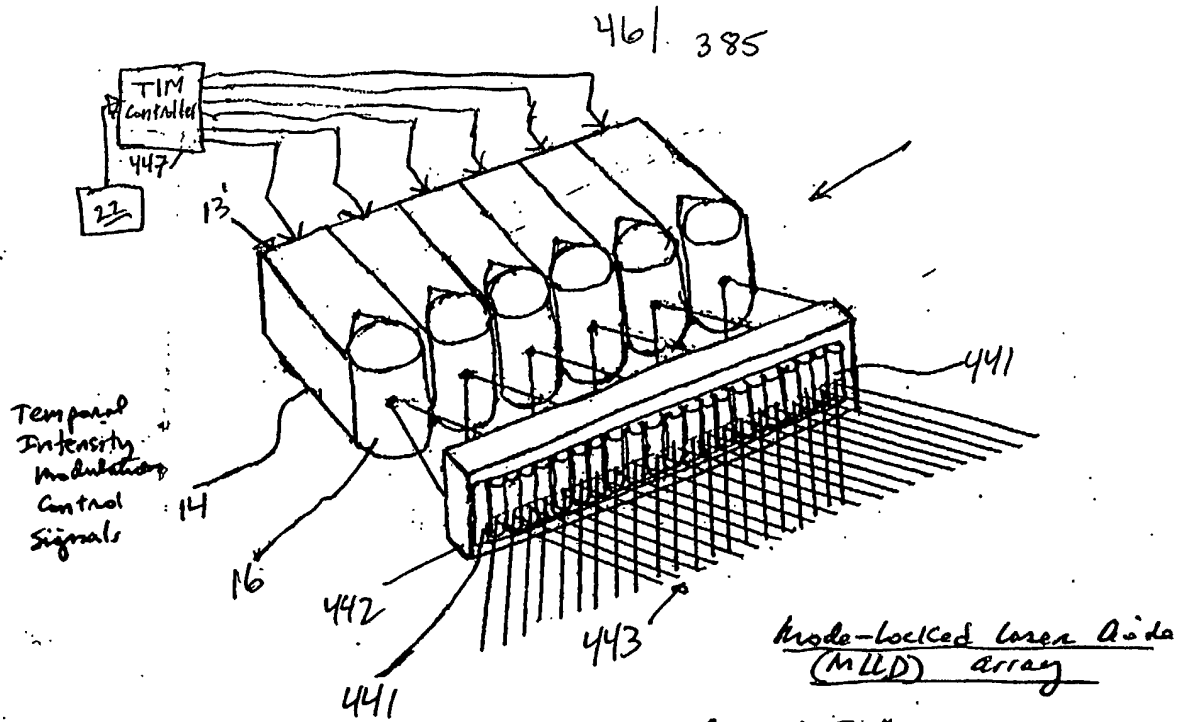
produce numerous substantially different time-varying speckle-noise patterns at the image detection array of the IFD Subsystem during the photo-integration time period thereof.

Temporally average the numerous substantially different time-varying speckle-noise patterns produced at the image detection array in the IFD Subsystem during the photo-integration time period thereof, so as to thereby reduce power of the speckle-noise pattern observed at the image detection array.

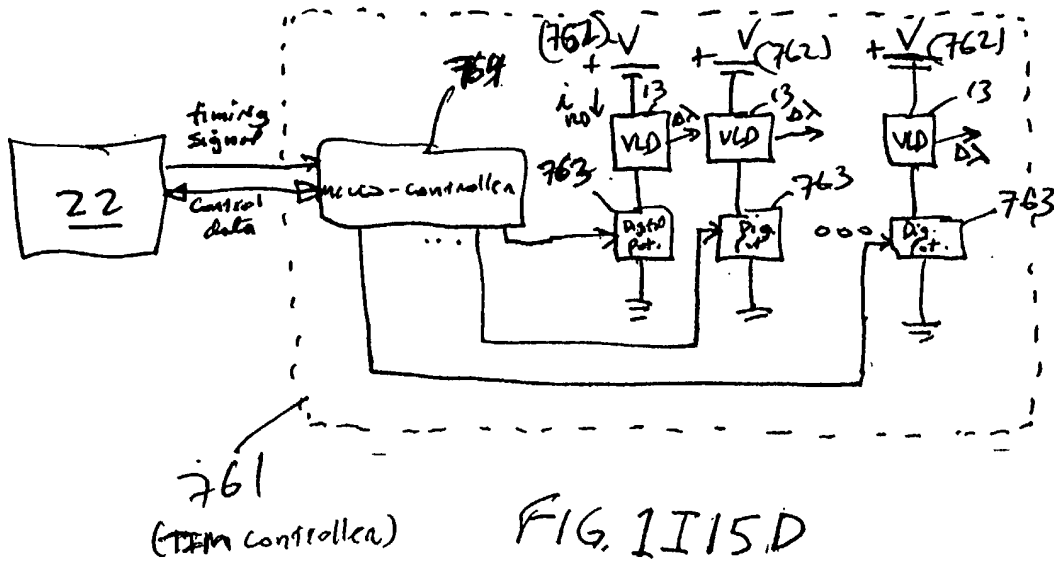
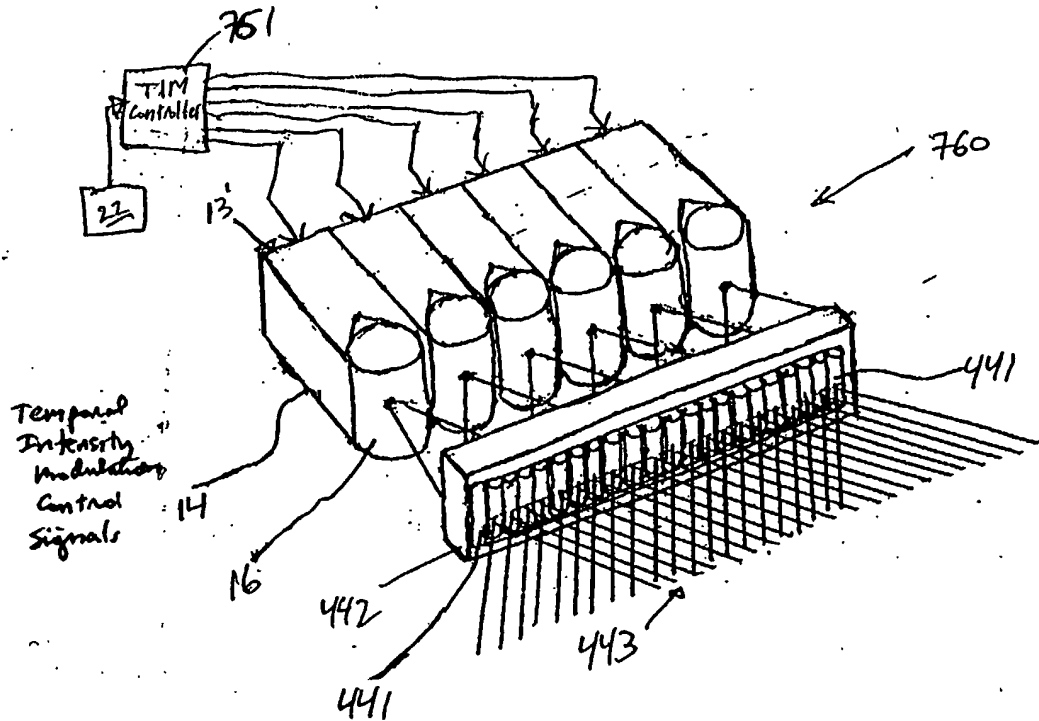
FIG 1I13B

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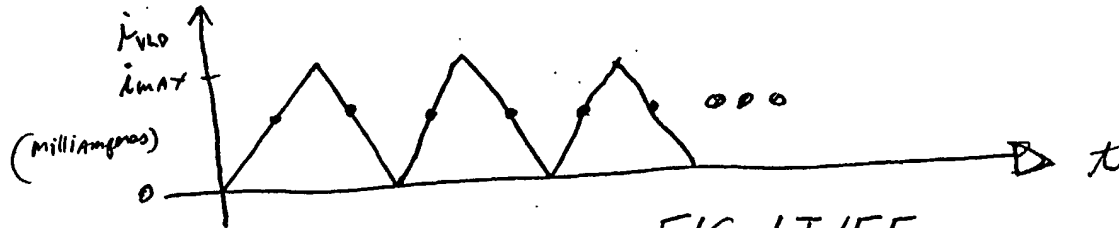


FIG. 1I15E

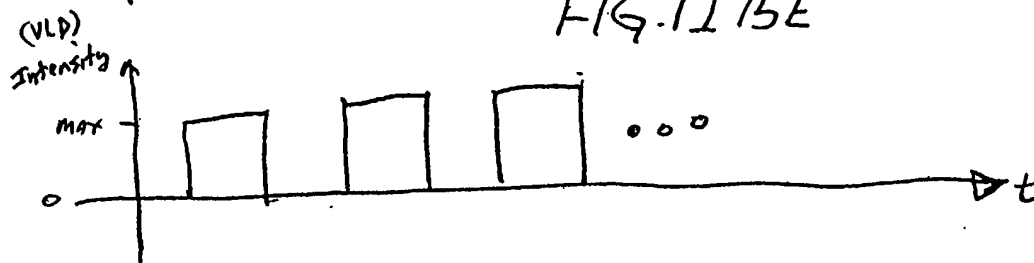


FIG. 1I15E

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Third Generalized Method of
Reducing Speckle-Noise Patterns
at Image Detection Array
of the FFD Subsystem (3)

(TIME)

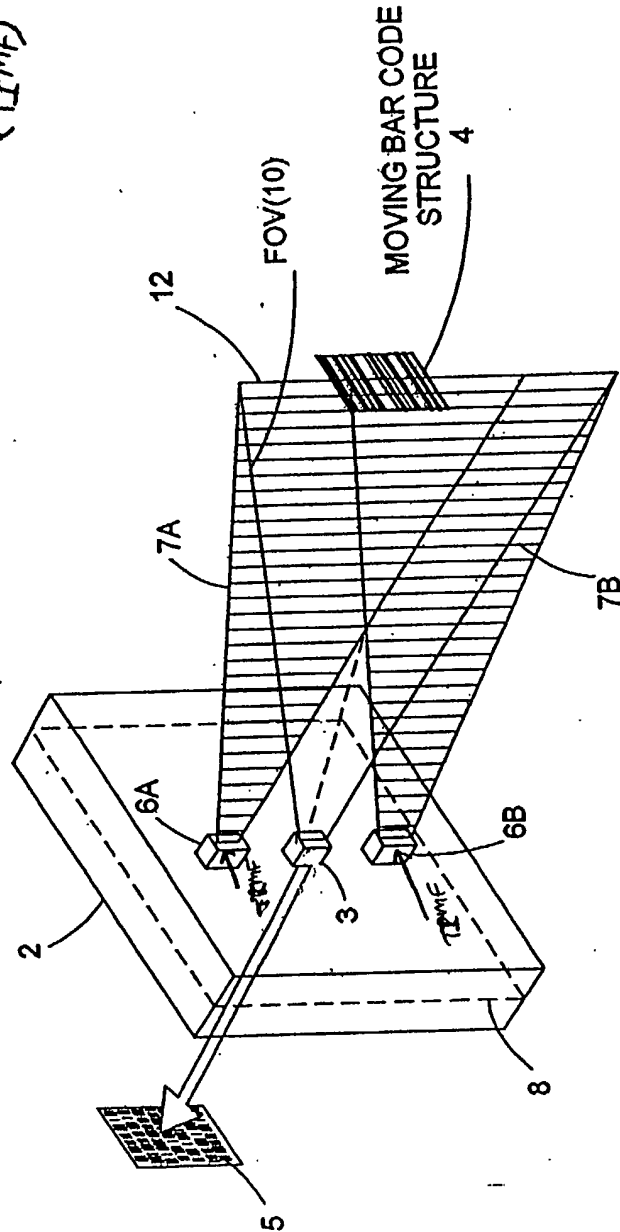


FIG. 1116

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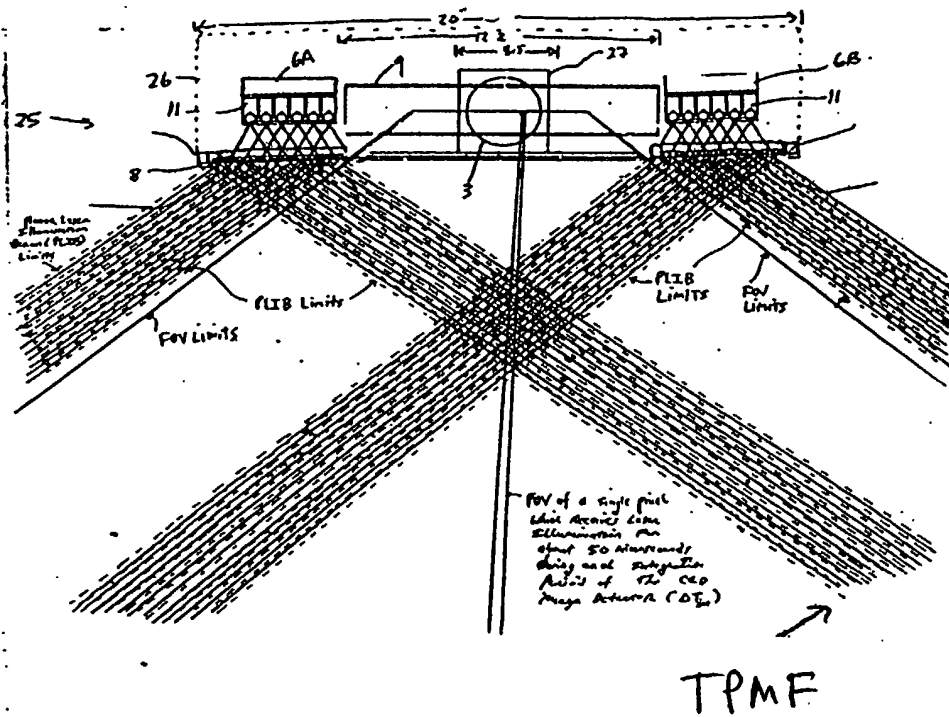


FIG. 1 I 16A

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Third Generalized Speckle-Noise Pattern Reduction Method
Of The Present Invention

Prior to illumination of the target with the planar laser illumination beam (PLIB), modulate the temporal *phase* of the transmitted PLIB ~~along the planar extent thereof~~ according to a *temporal phase* modulation function (TPMF) so as to:

produce numerous substantially different time-varying speckle-noise patterns at the image detection array of the IFD Subsystem during the photo-integration time period thereof.

↓

Temporally average the numerous substantially different time-varying speckle-noise patterns produced at the image detection array in the IFD Subsystem during the photo-integration time period thereof, so as to thereby reduce power of the speckle-noise pattern observed at the image detection array.

FIG 1I/6B

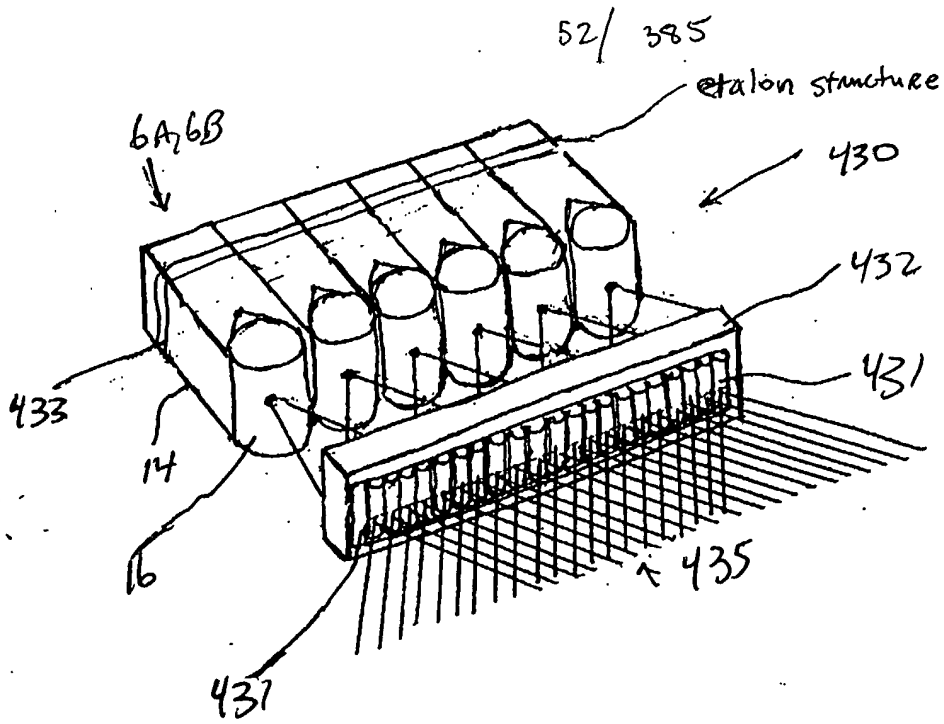


FIG. 1I17A

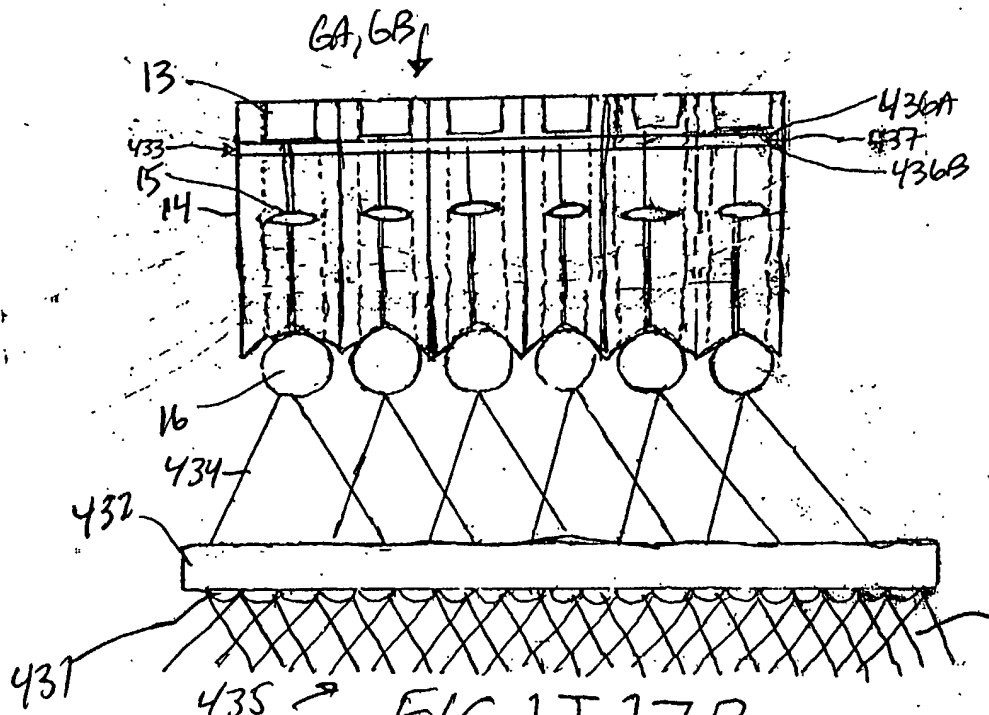


FIG. 1I17B

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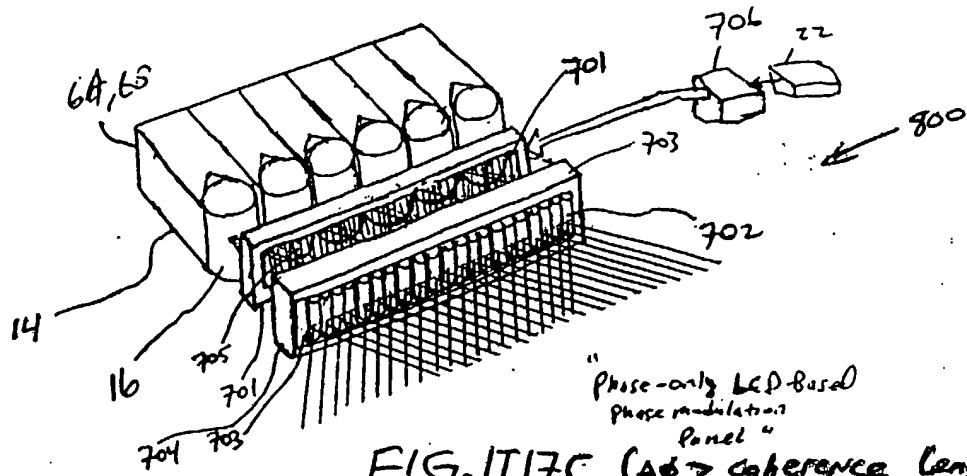


FIG. 1I17C ($\Delta\phi >$ coherence length) of VLD

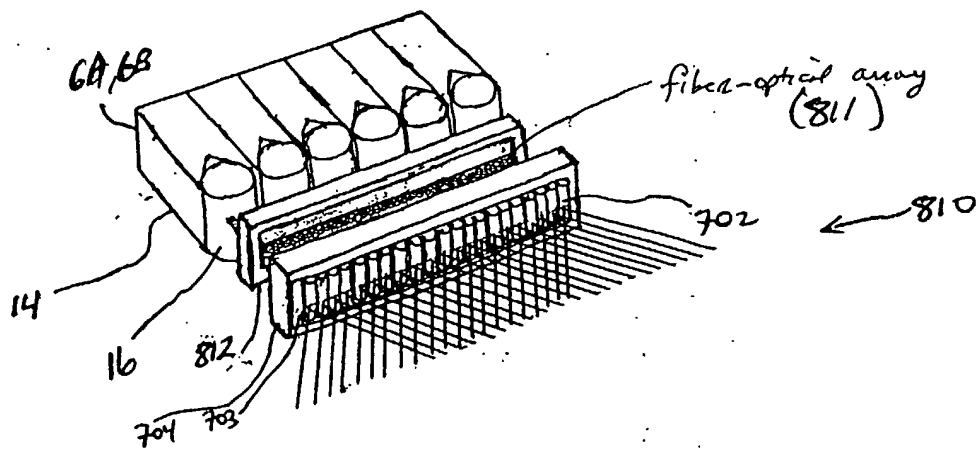


FIG. 1I17D

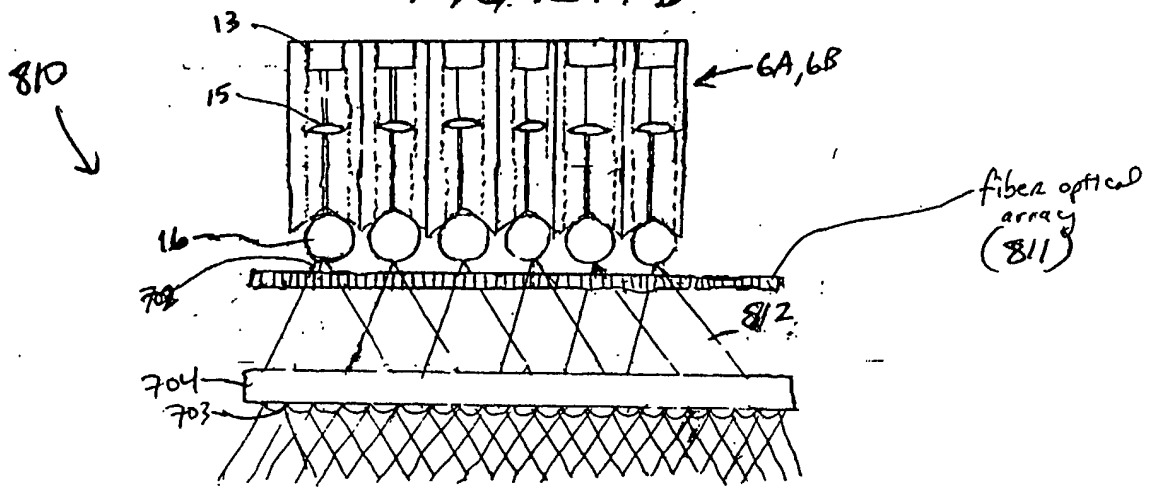


FIG. 1I17E

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Fourth Generalized Method of
Reducing Speckle-Noise Patterns
at Image Detection Array
of the FFD Subsystem (3)

(TFMP)

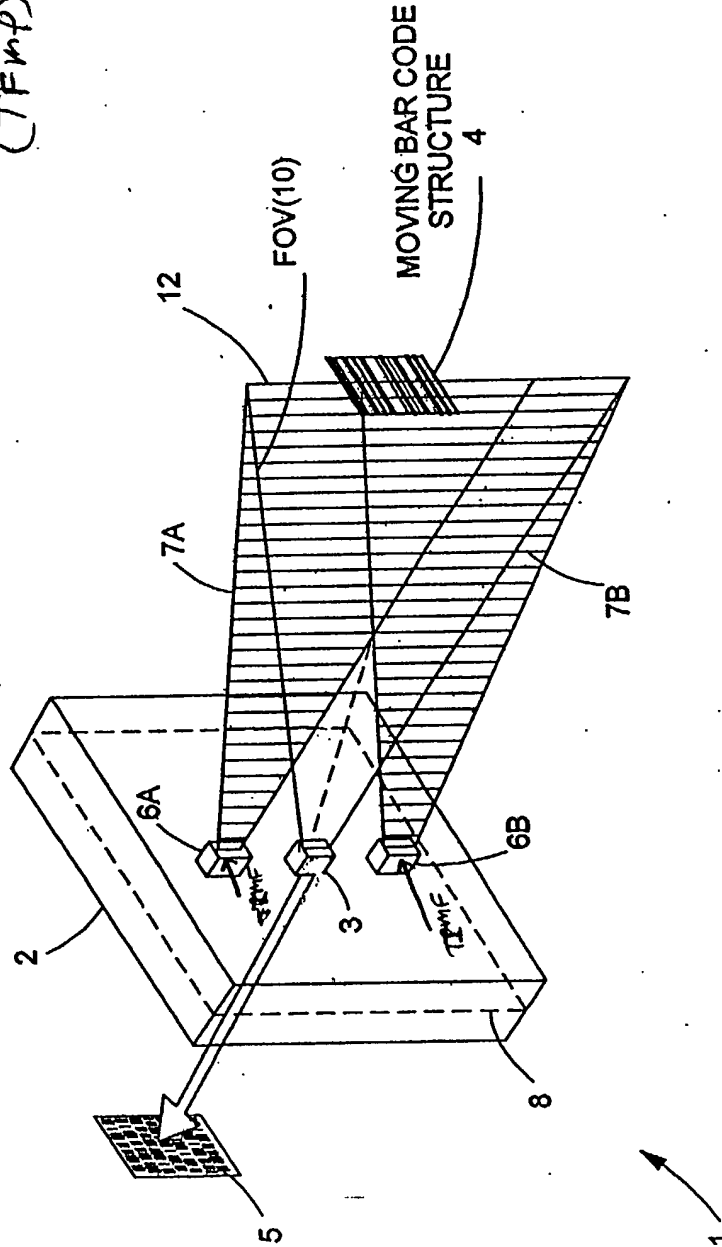


FIG. 1118

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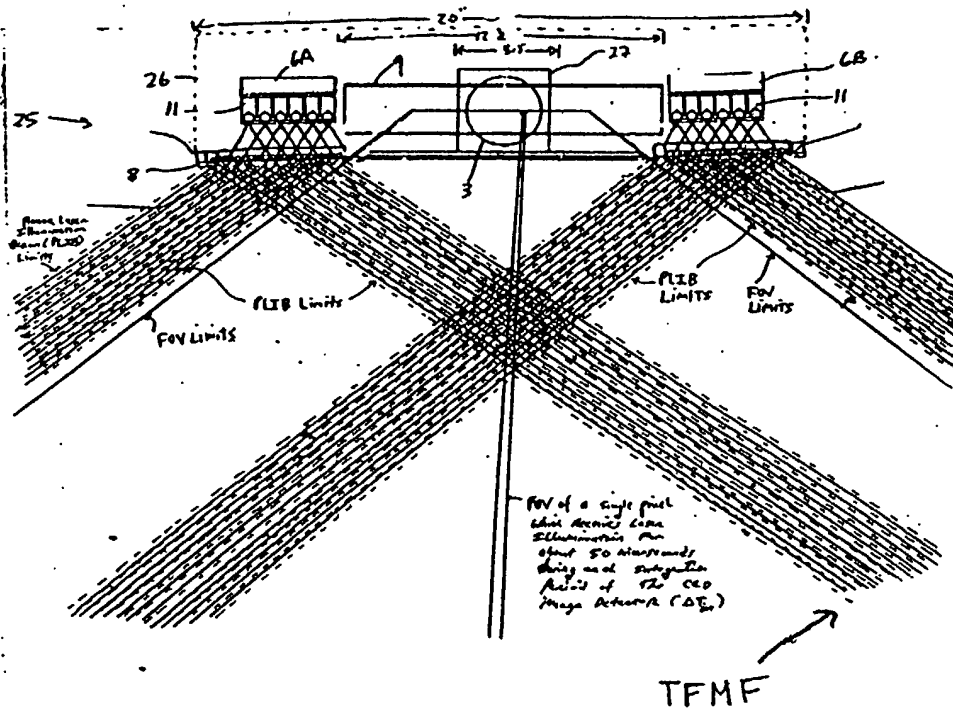


FIG. 1 I 18A

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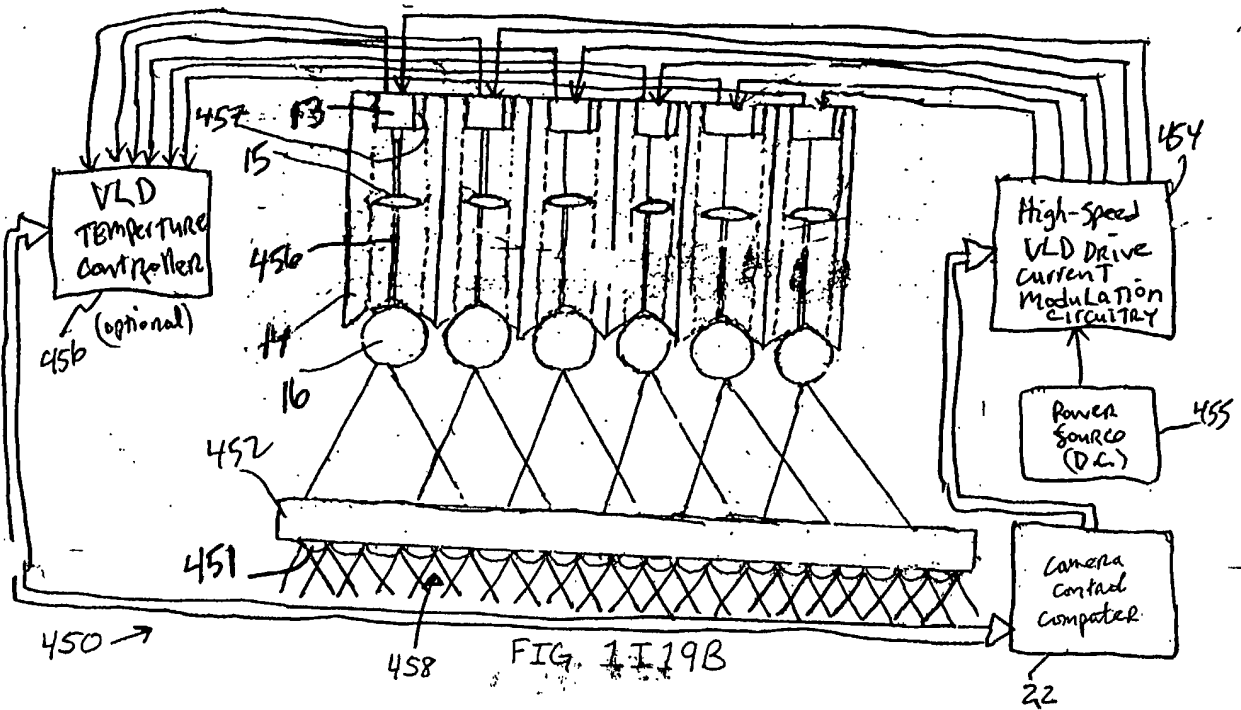
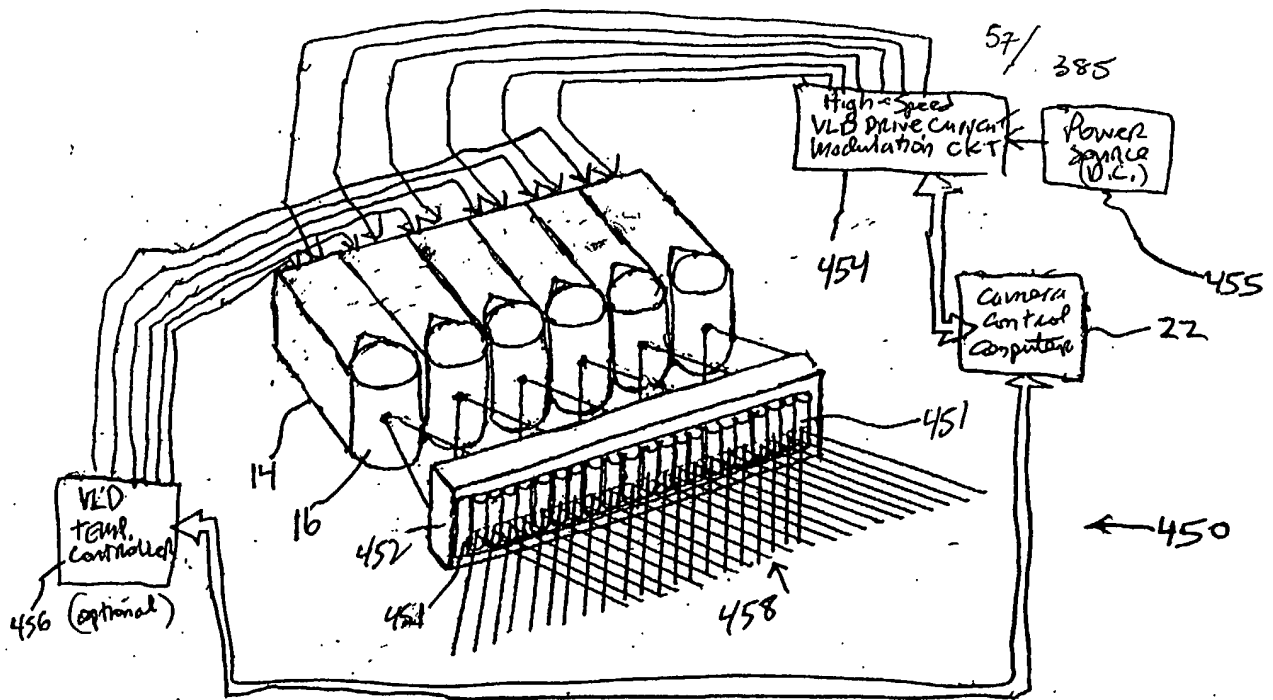
Fourth Generalized Speckle-Noise Pattern Reduction Method
Of The Present Invention

Prior to illumination of the target with the planar laser illumination beam (PLIB), modulate the temporal frequency of the transmitted PLIB according to a temporal intensity modulation function (T IMF) so as to

produce numerous substantially different time-varying speckle-noise patterns at the image detection array of the IFD Subsystem during the photo-integration time period thereof.

Temporally average the numerous substantially different time-varying speckle-noise patterns produced at the image detection array in the IFD Subsystem during the photo-integration time period thereof, so as to thereby reduce power of the speckle-noise pattern observed at the image detection array.

FIG 1 I 18 B



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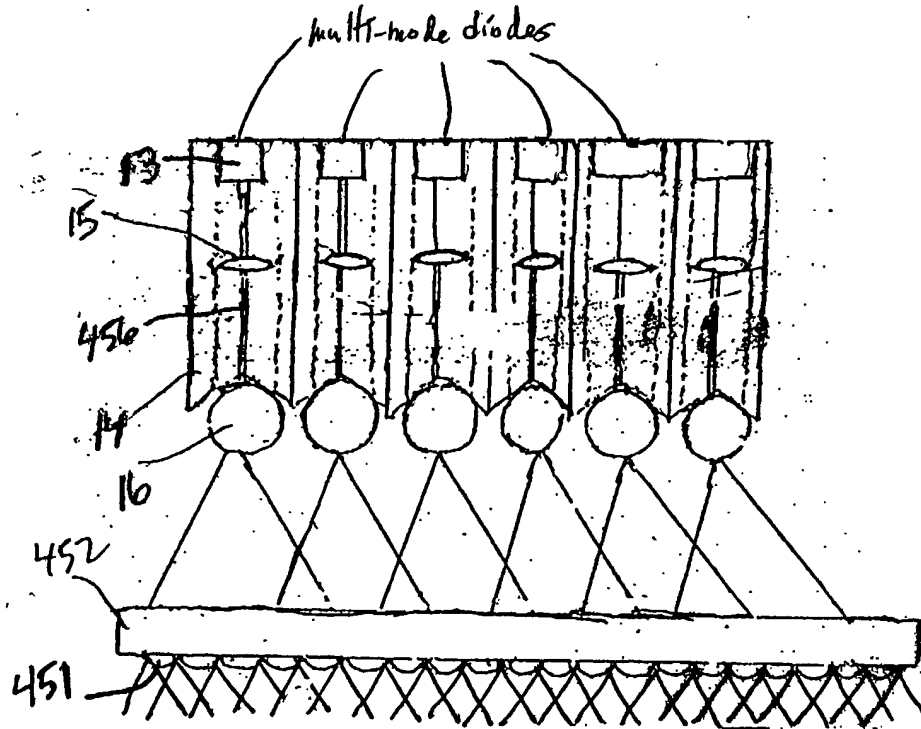


FIG 1I19C

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Fifth GENERALIZED METHOD
of Reducing Speckle-Noise
PATTERNS AT IMAGE
Detection array of the
FFD Subsystem (3)

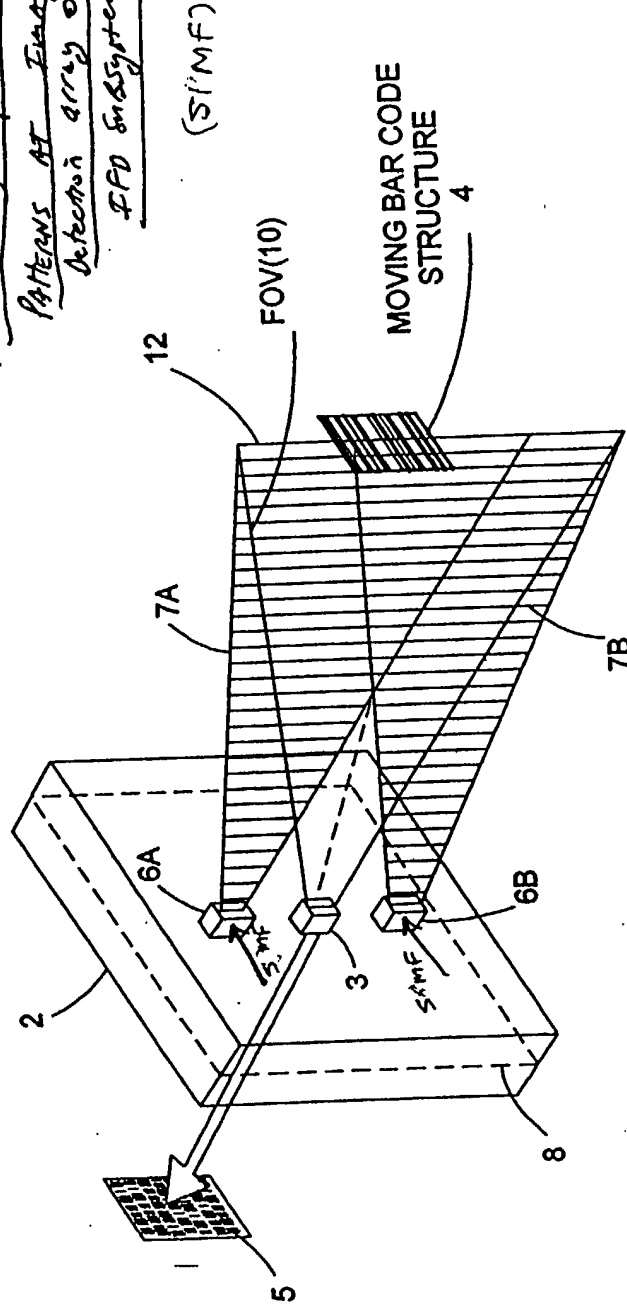
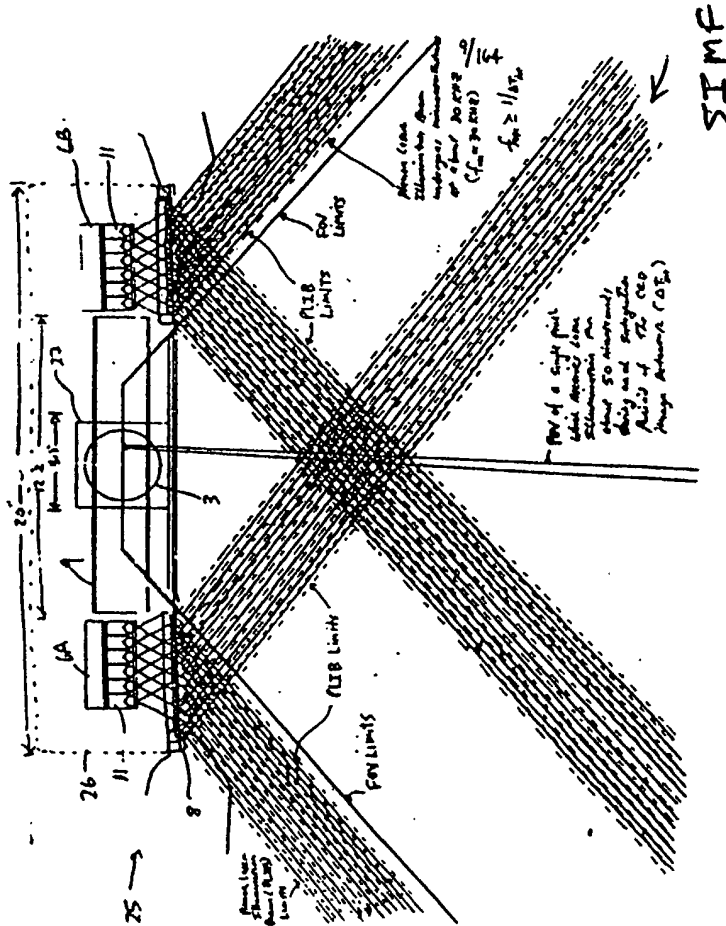


FIGURE 20

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Prior to object illumination

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Fifth Generalized Speckle-Noise Pattern Reduction Method
Of The Present Invention

Prior to illumination of the target with the planar laser illumination beam (PLIB), modulate the spatial intensity of the transmitted PLIB along the planar extent thereof according to a spatial intensity modulation function (SIMF) so as to

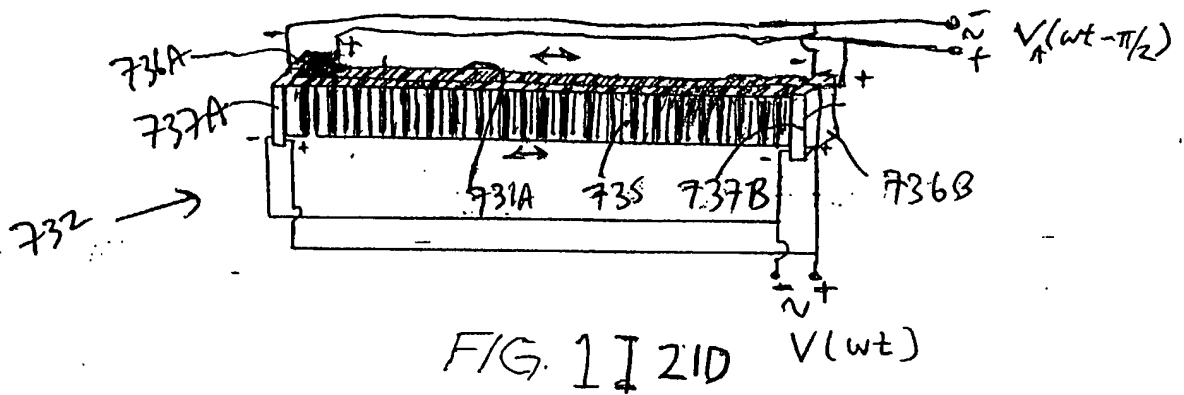
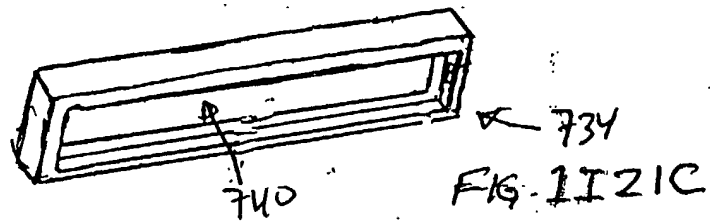
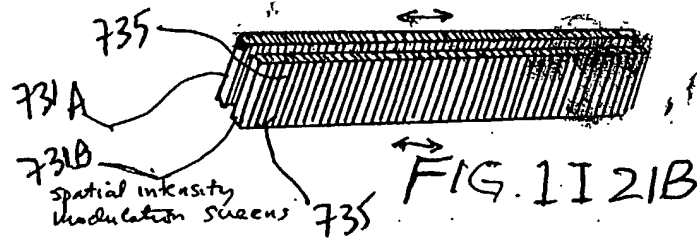
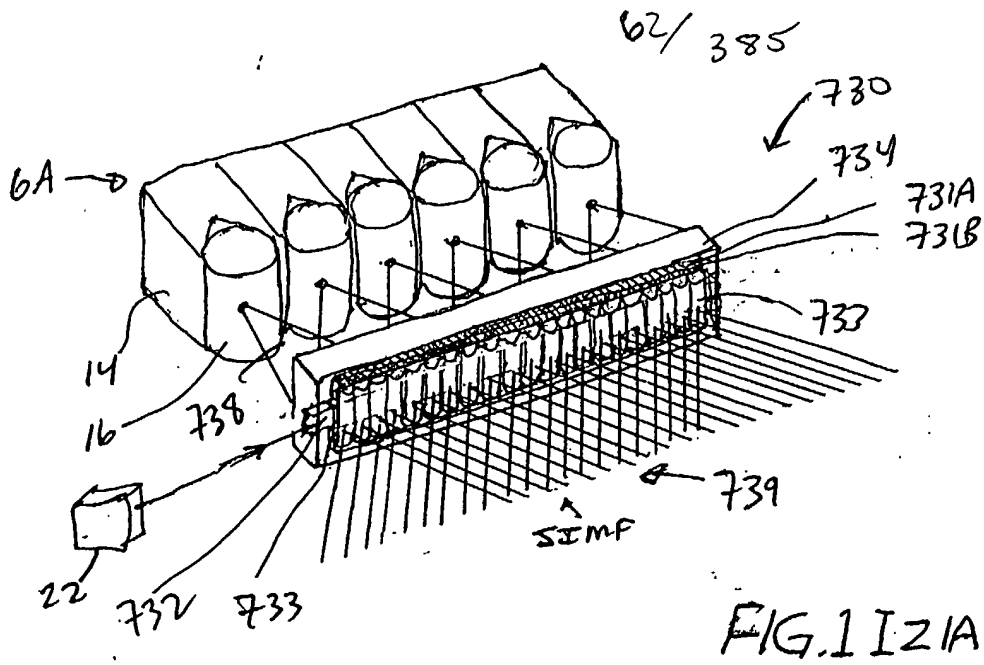
produce numerous substantially different time-varying speckle-noise patterns at the image detection array of the IFD Subsystem during the photo-integration time period thereof.

A

Temporally average the numerous substantially different time-varying speckle-noise patterns produced at the image detection array in the IFD Subsystem during the photo-integration time period thereof, so as to thereby reduce power of the speckle-noise pattern observed at the image detection array.

B

FIG. 1I20B



Generalized Method of
Reducing Speckle-Noise Patterns
at Image Detection Array
of the IPD Subsystem

(SIMF)

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385

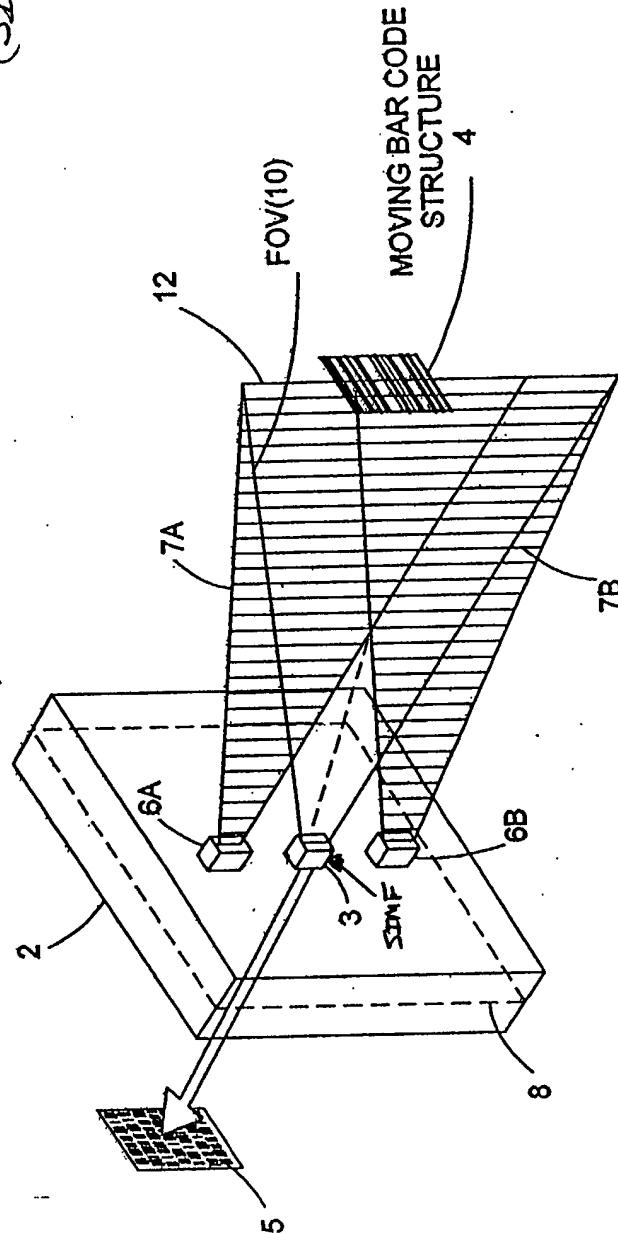
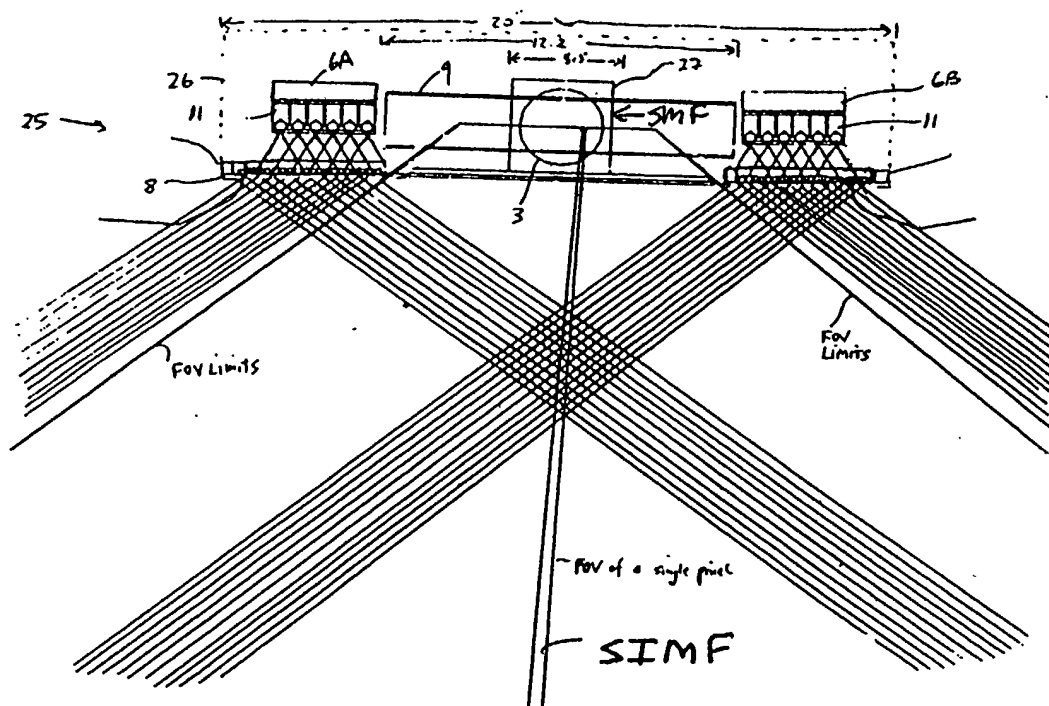


FIG. 11 22

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Sixth Generalized Speckle-Noise Pattern Reduction Method
Of The Present Invention

After illumination of the target with the planar laser illumination beam (PLIB), modulate the spatial intensity of the reflected/scattered (i.e. received) PLIB along the planar extent thereof according to a spatial intensity modulation function (SIMF) so as to:

produce numerous substantially different time-varying speckle-noise patterns at the image detection array of the IFD Subsystem during the photo-integration time period thereof.

Temporally average the many substantially different time-varying speckle-noise patterns produced at the image detection array in the IFD Subsystem during the photo-integration time period thereof, so as to thereby reduce the speckle-noise pattern observed at the image detection array.

FIG. 1I 22B

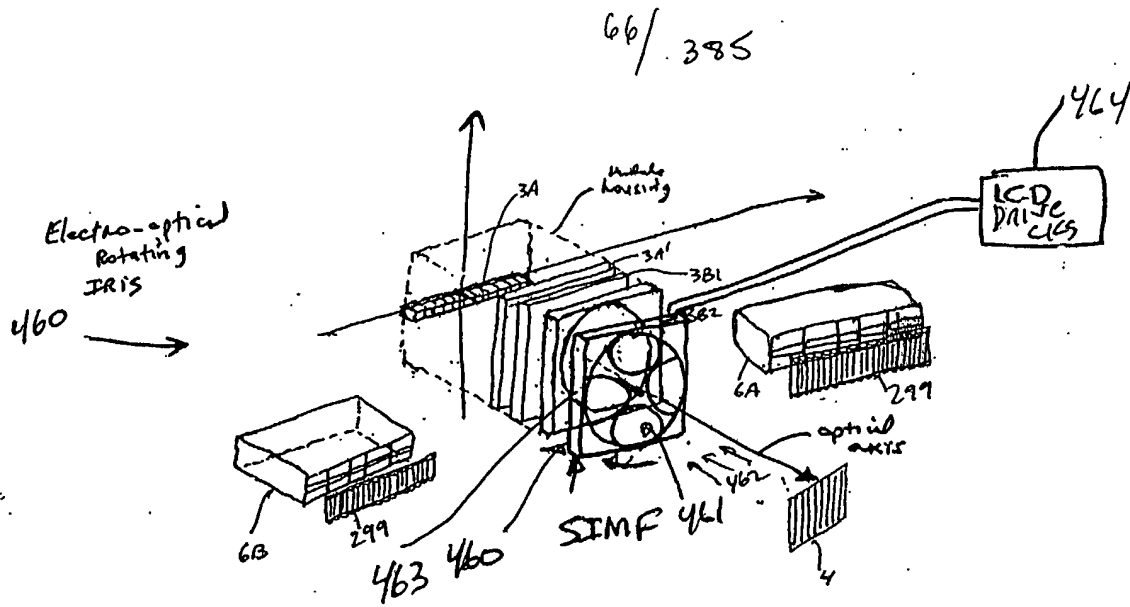


FIG. 1I 23A

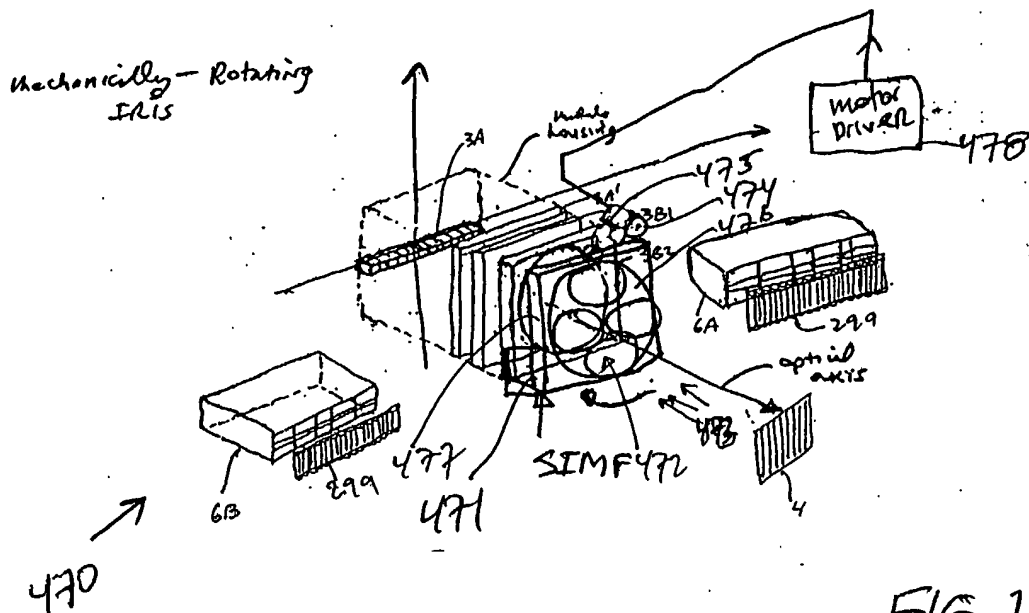


FIG. 1I 23B

Seventh Generalized Method of
Reducing Spindle-Noise Patterns
at Image Detection Array
of 2D IFD Subsystem

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(TIME)

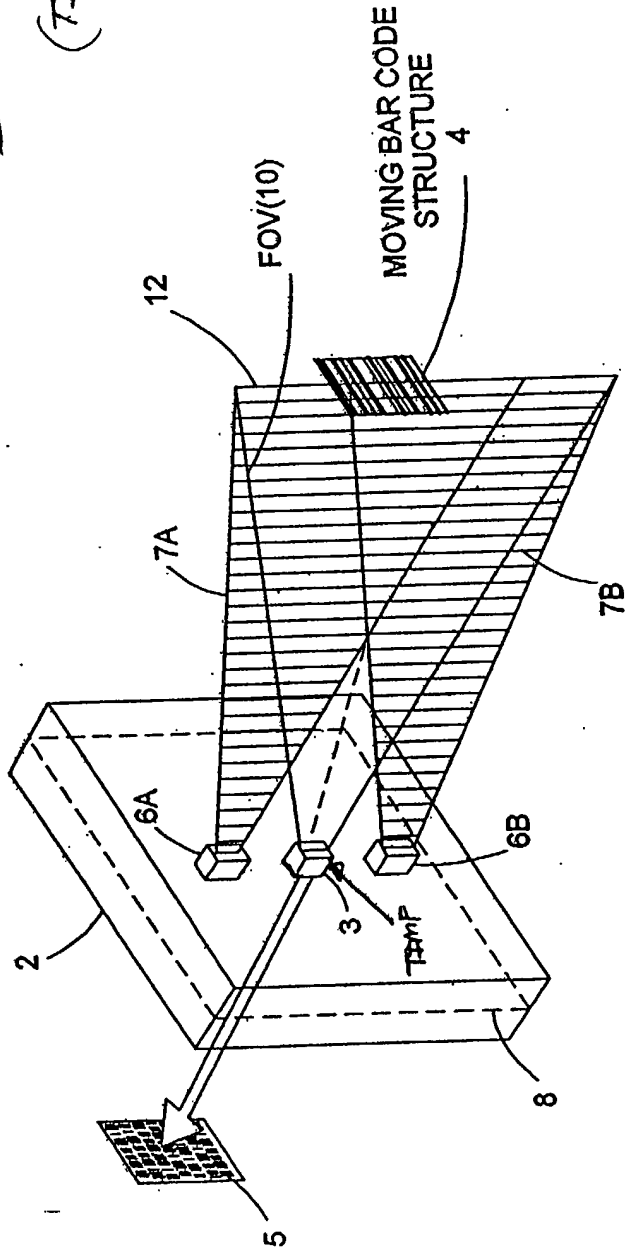


FIG. 1124

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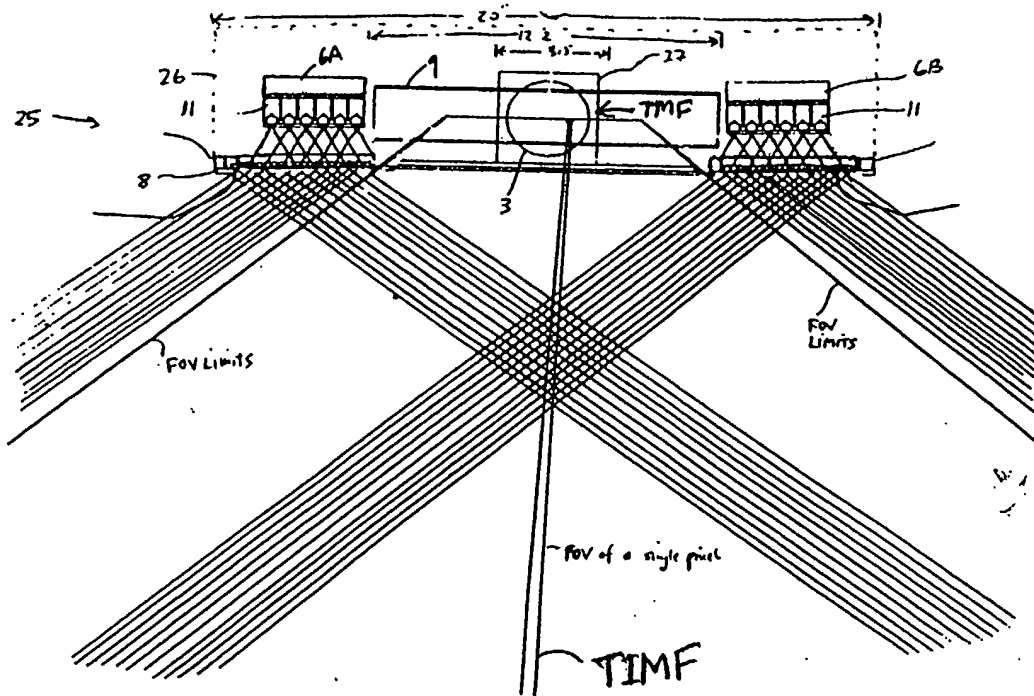


FIG. 1I24A

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Seventh Generalized Speckle-Noise Pattern Reduction Method
Of The Present Invention

After illumination of the target with the planar laser illumination beam (PLIB), modulate the temporal intensity of the reflected/scattered (i.e. received) PLIB along the planar extent thereof according to a temporal intensity modulation function (TIMF) so as to :

produce many substantially different time-varying speckle-noise patterns at the image detection array of the IFD Subsystem during the photo-integration time period thereof.

Temporally average the many substantially different time-varying speckle-noise patterns produced at the image detection array in the IFD Subsystem during the photo-integration time period thereof, so as to thereby reduce the speckle-noise pattern observed at the image detection array.

FIG. 1I 24B

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EIGHT GENERALIZED METHOD OF REDUCING THE SPECKLE PATTERN
NOISE OBSERVED IN PLIIM-BASED IMAGING SYSTEMS

A

Use a PLIIM-BASED Imager to produce a series of consecutively captured digital images of an object over a series of photo-integration time periods of the PLIIM-Based Imager, wherein each digital image of the object includes a substantially different speckle noise pattern produced by natural oscillatory micro-motion and/or forced oscillatory micro-movement of the Imager relative to the object during operation of the PLIIM-Based Imager.

B

Store the series of consecutively captured digital images of the object in buffer memory within the PLIIM-Based Imager.

C

Add relatively small (e.g. 3x3) windowed image processing filters to the additively combine and average the pixel data in the series of consecutively captured digital images so as to produce a reconstructed digital image having a speckle noise pattern with reduced RMS power.

FIG. 1124D

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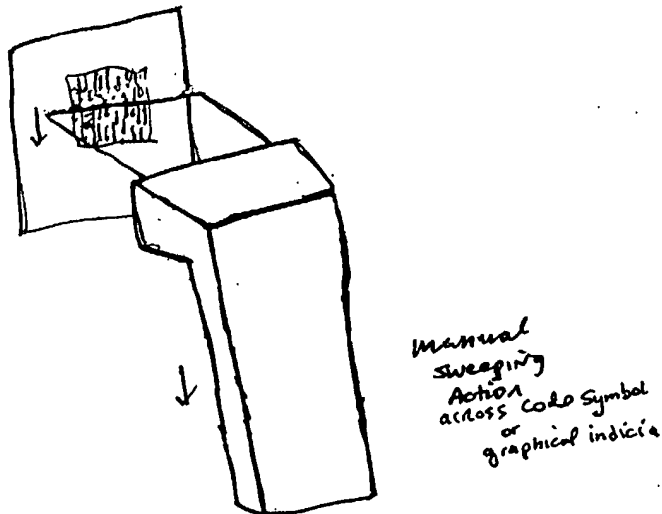


FIG. 1I24E

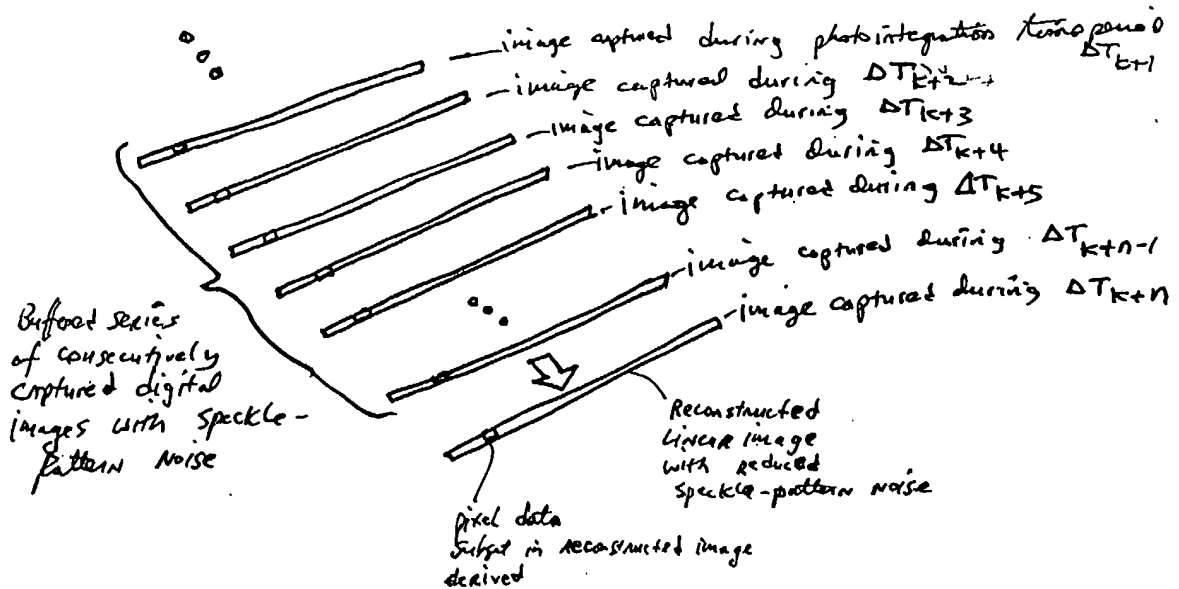


FIG. 1I24F

Case: Linear Image

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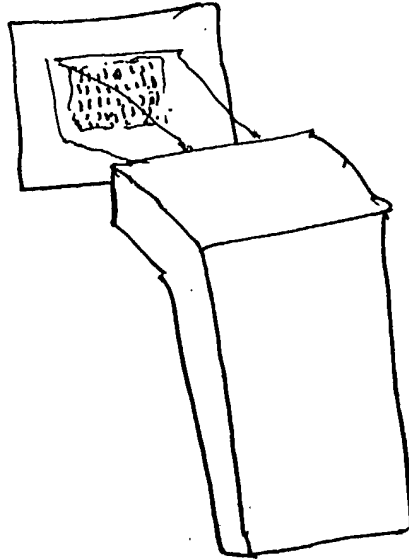


FIG. 1I24G

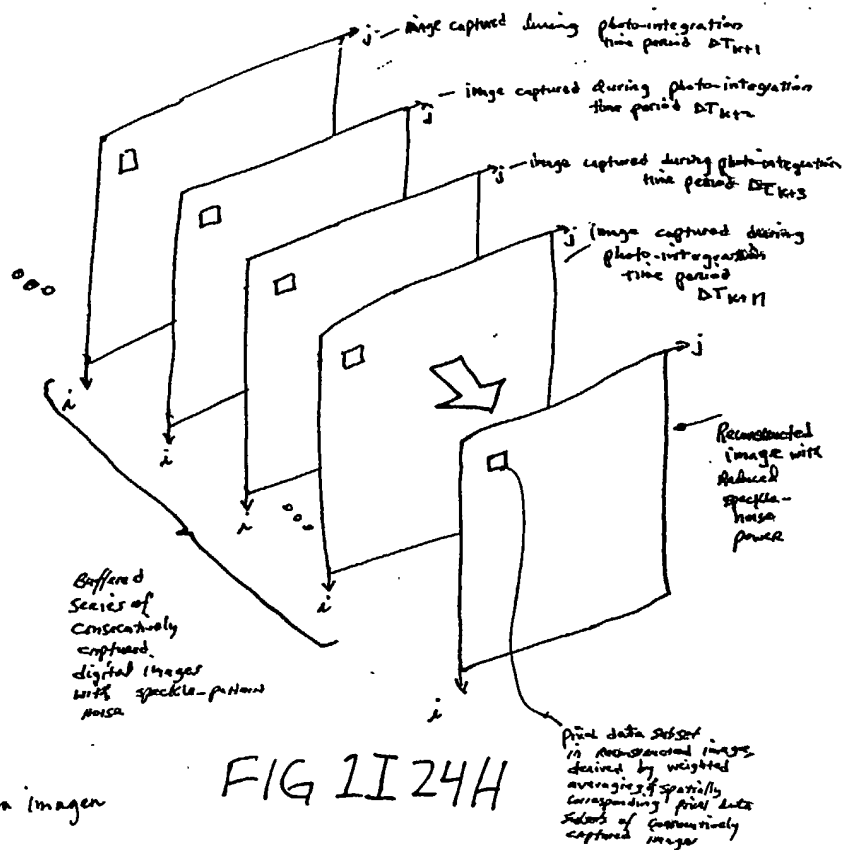


FIG 1I24H

Case: 2D Area Images

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NINTH GENERALIZED METHOD OF REDUCING SPECKLE PATTERN
NOISE IN PLIM-BASED IMAGING SYSTEMS

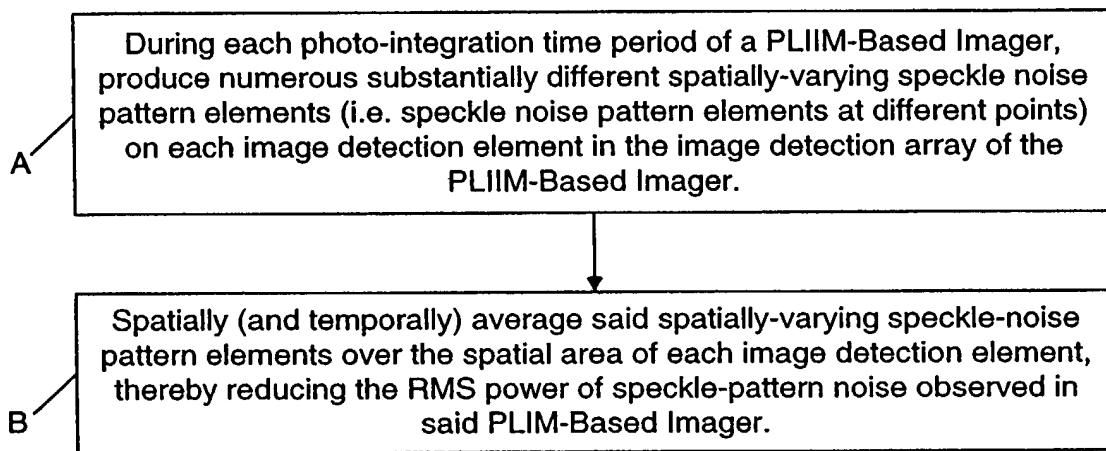
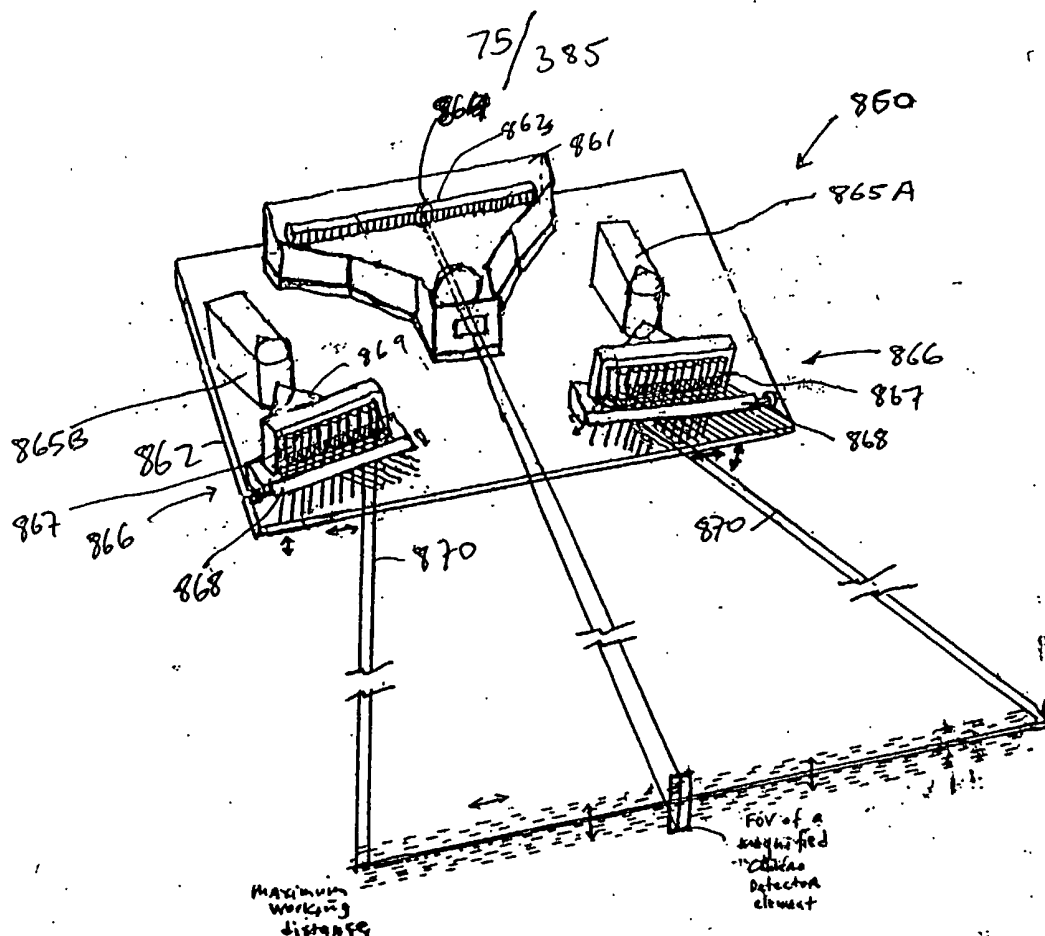


FIG. 11241



- * Lateral and Transverse Flexion of PLIB

FIG. 1I25A1

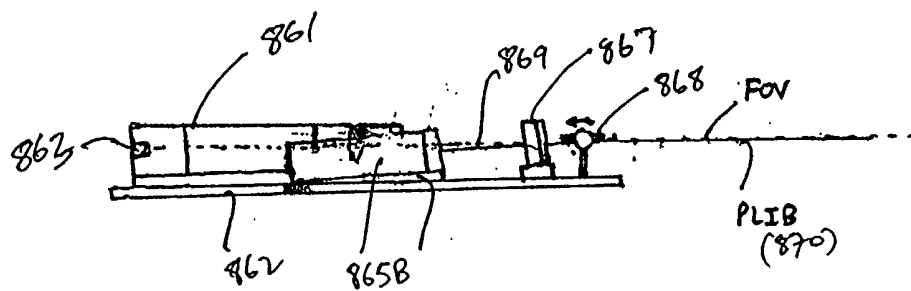
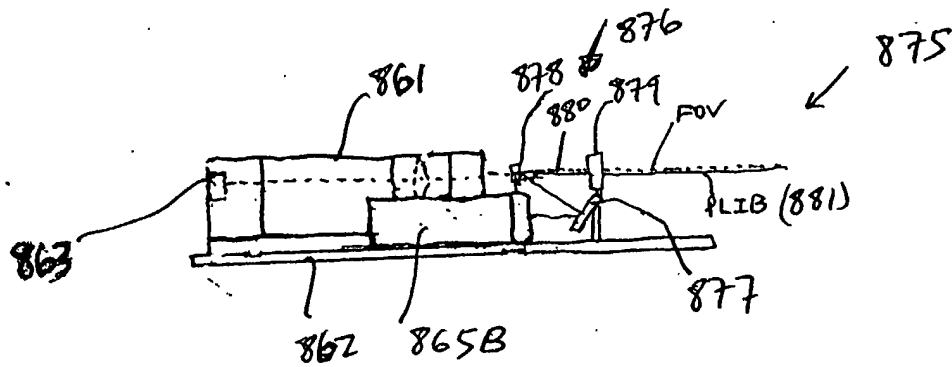
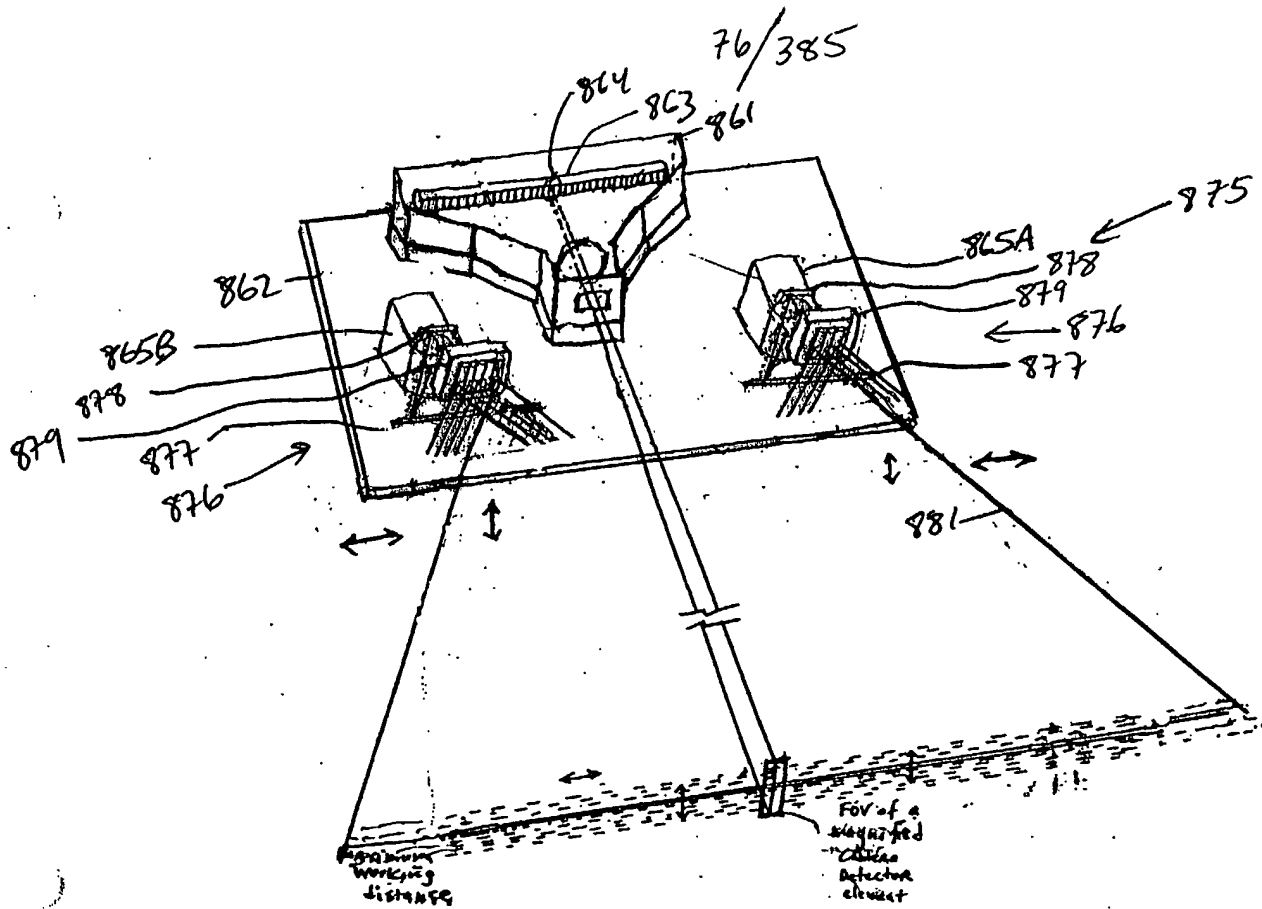
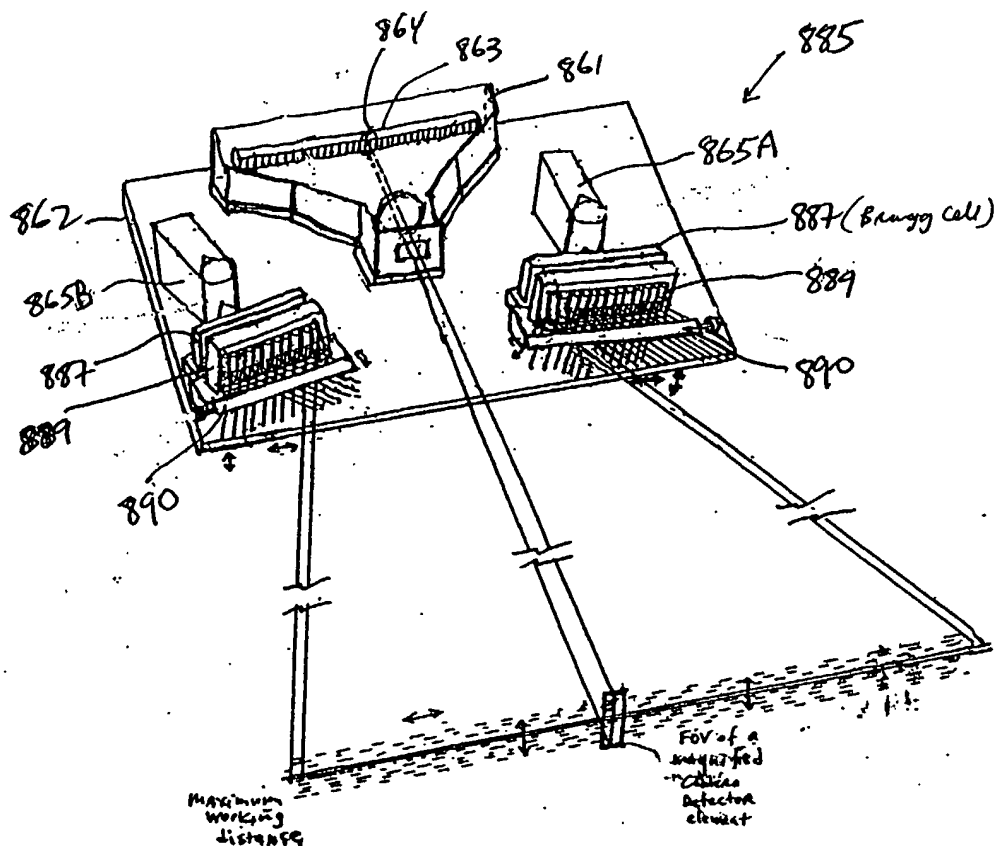


FIG. 1 IZ5A2



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* Lateral and Transverse Misalignment of PLIB

FIG. 1I25C1

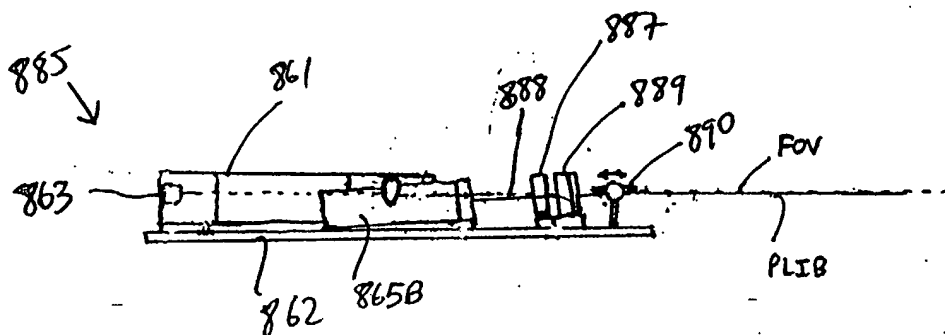
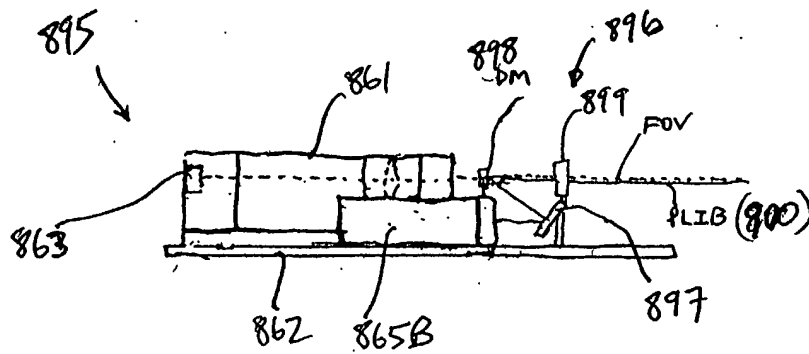
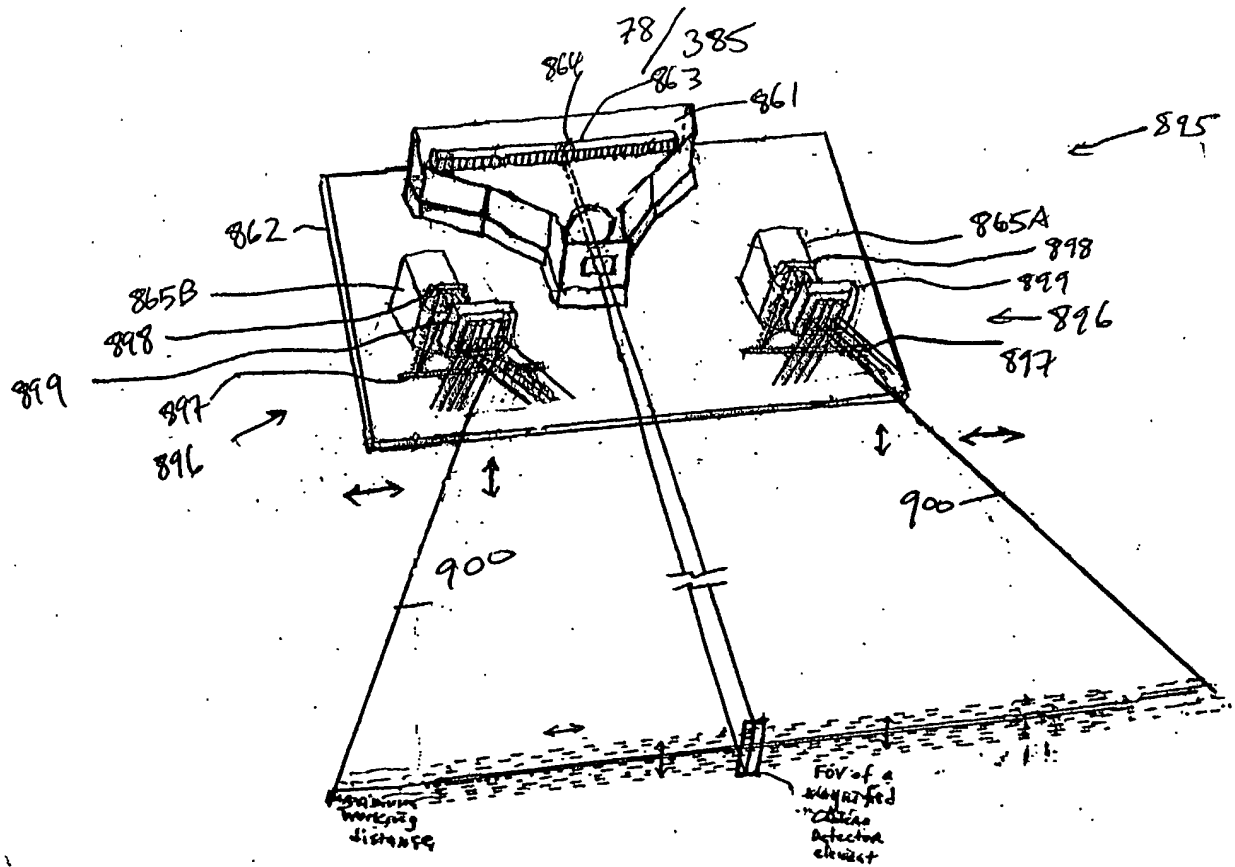
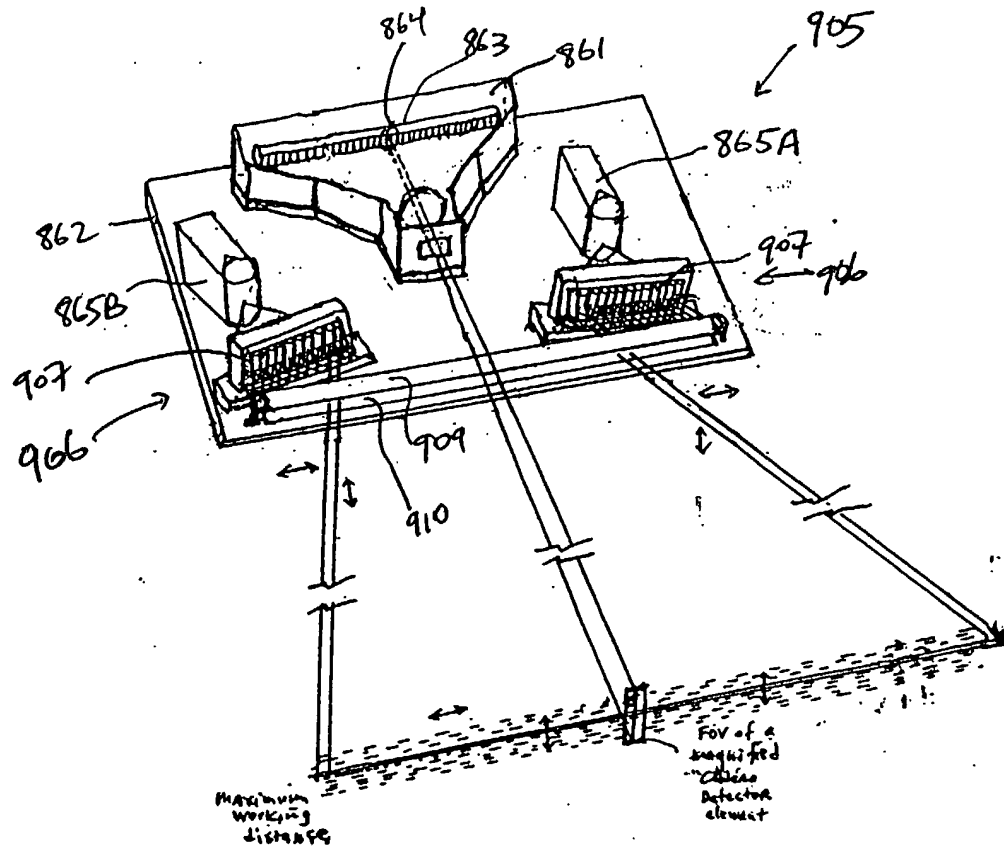


FIG. 1I25C2



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* Lateral and Transverse Misalignment of PLIB

905

FIG. 1I25E1

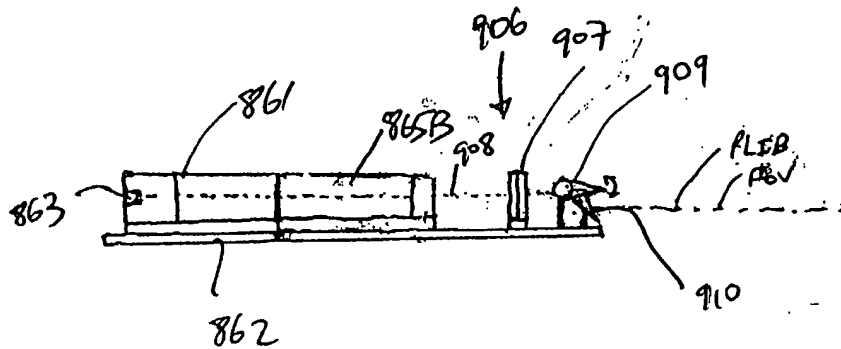
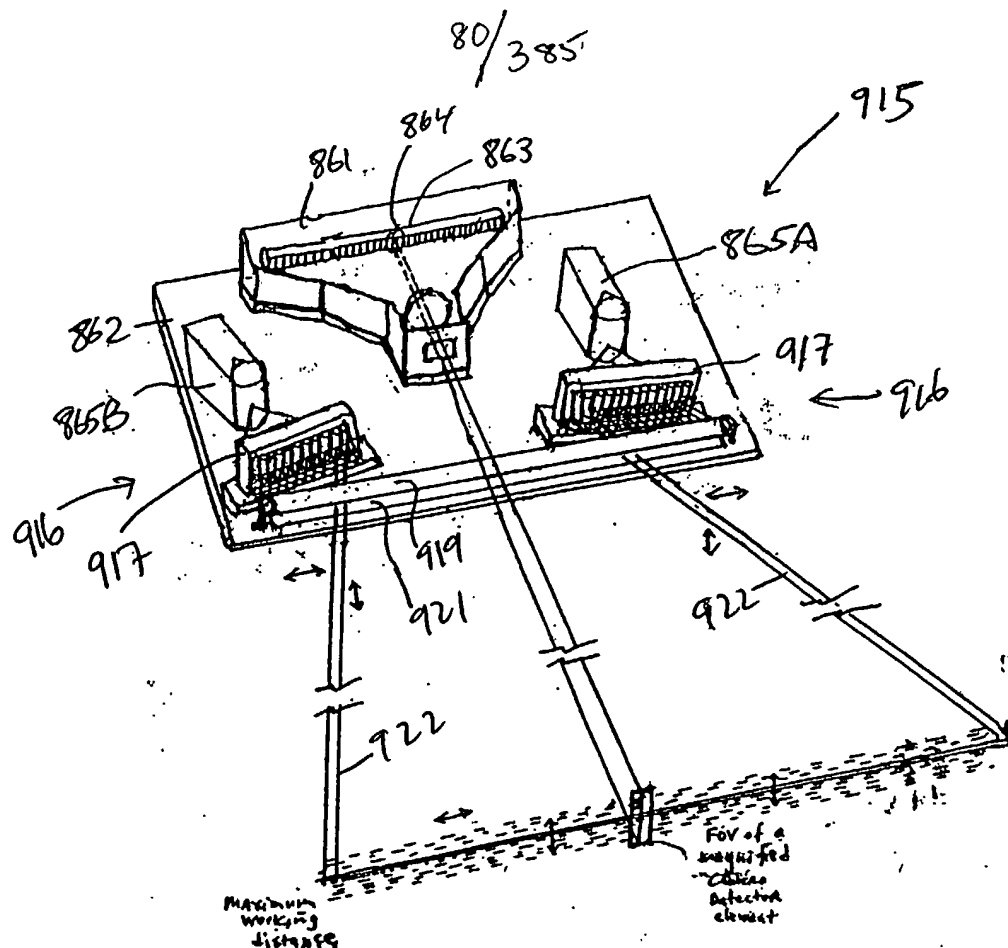


FIG. 1I25E2



- * Lateral and Transverse Microradiation of ALIB

FIG. 1I25F1

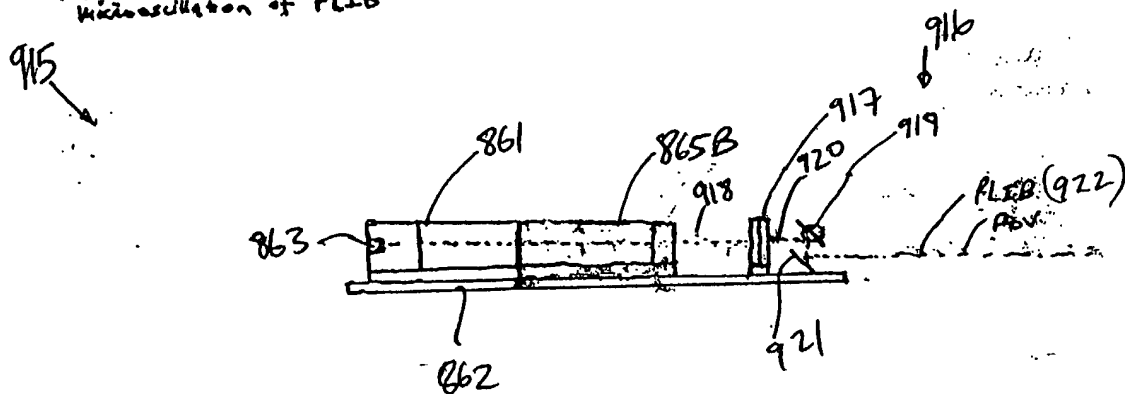
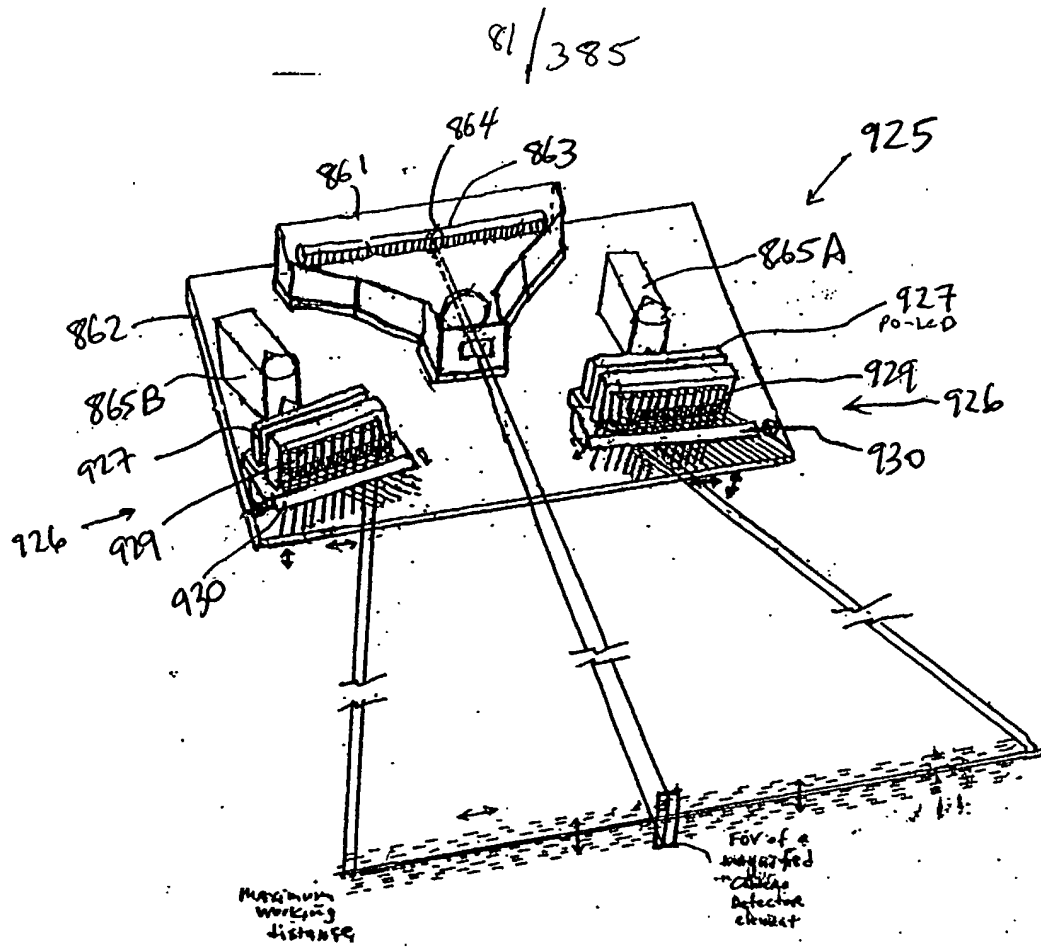


FIG. 1I 25 F2



* Lateral and Transverse Misalignment of PLIB

925

FIG. 1I25G1

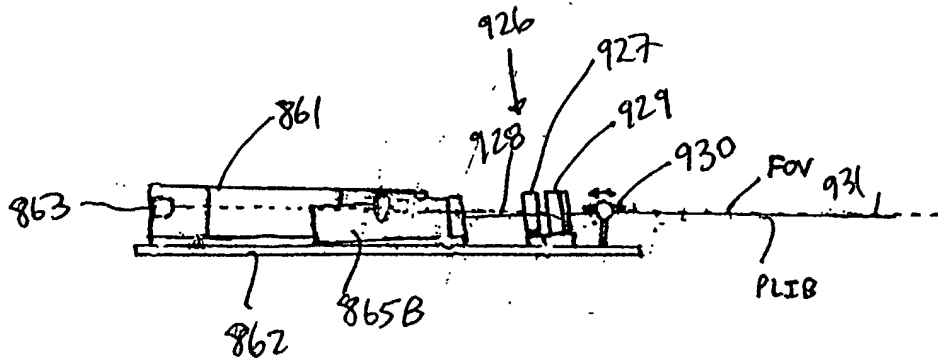
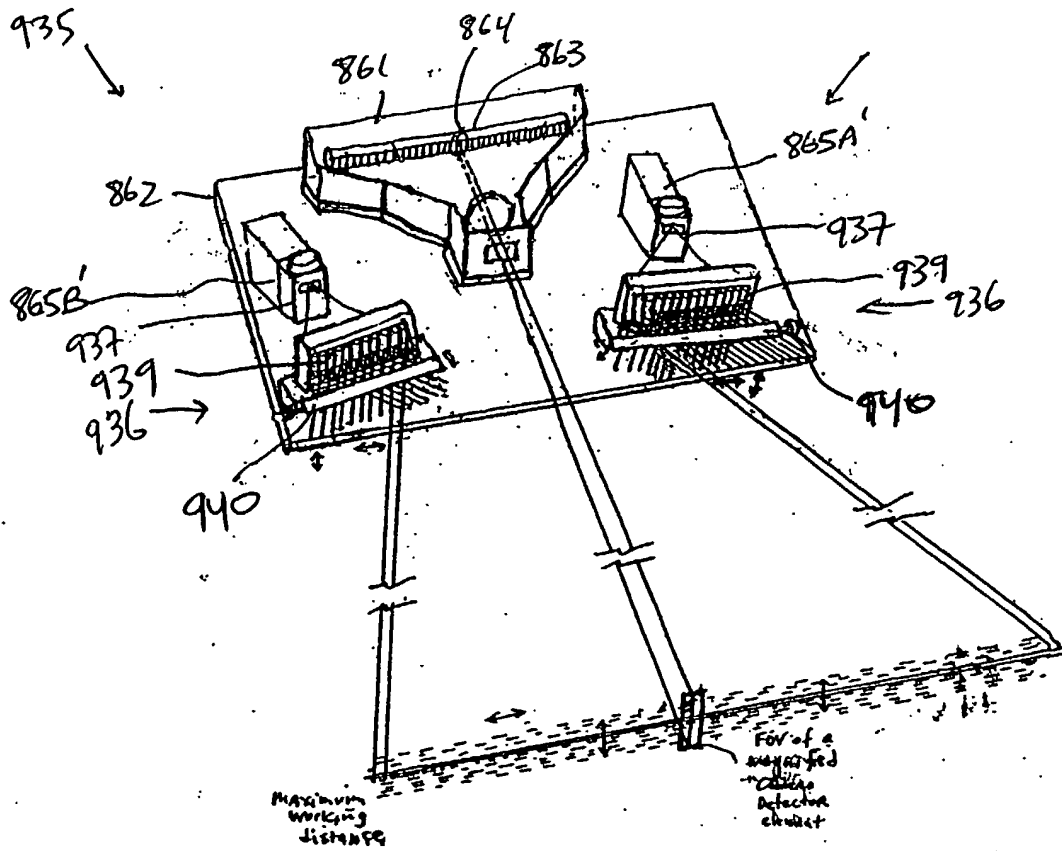


FIG. 1I25G2

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* Lateral and Transverse Misalignment of PLIB

FIG. 1I25H1

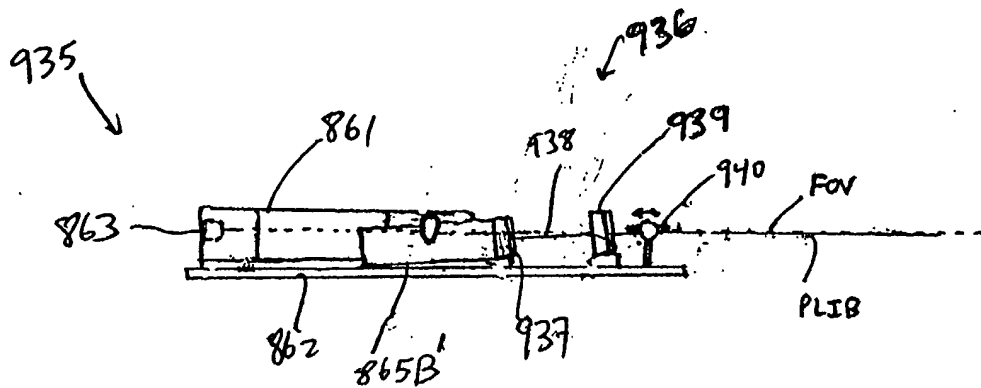
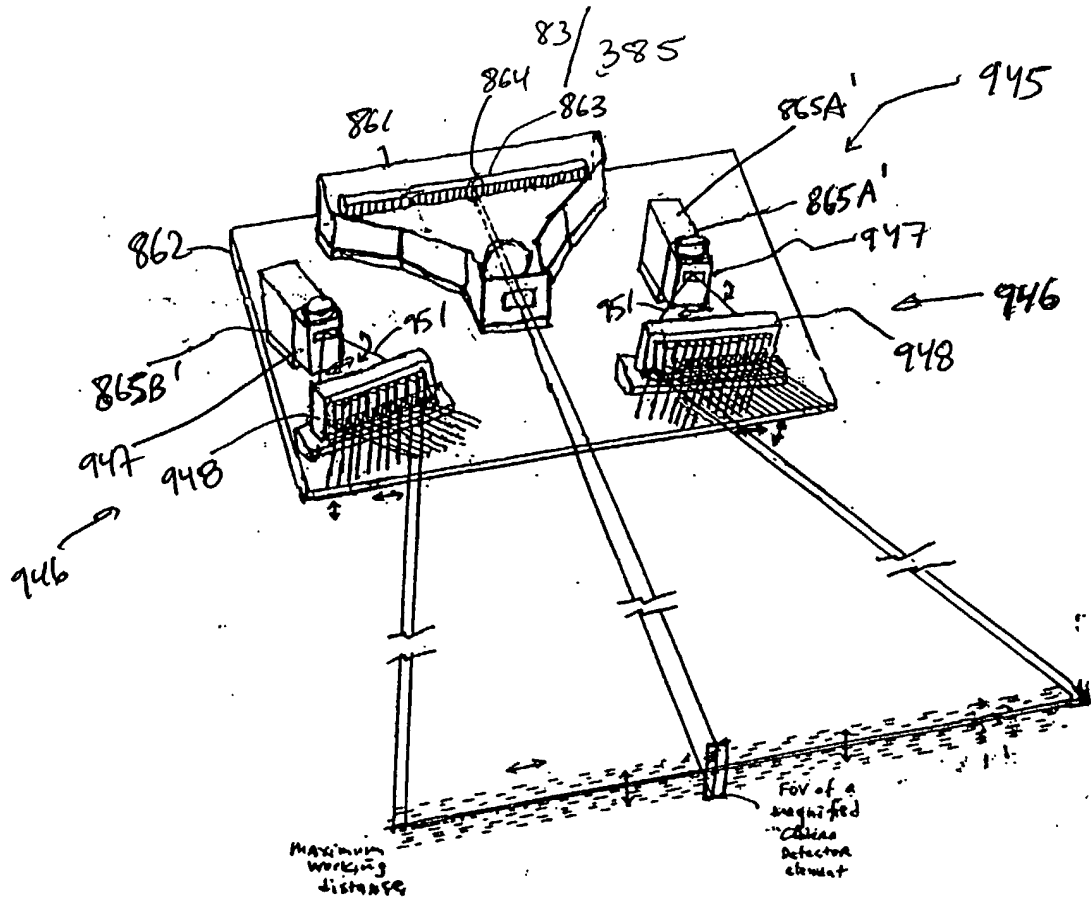


FIG. 1I25H2



Lateral and Transverse Oscillation of PLIB

FIG. 1I25I1

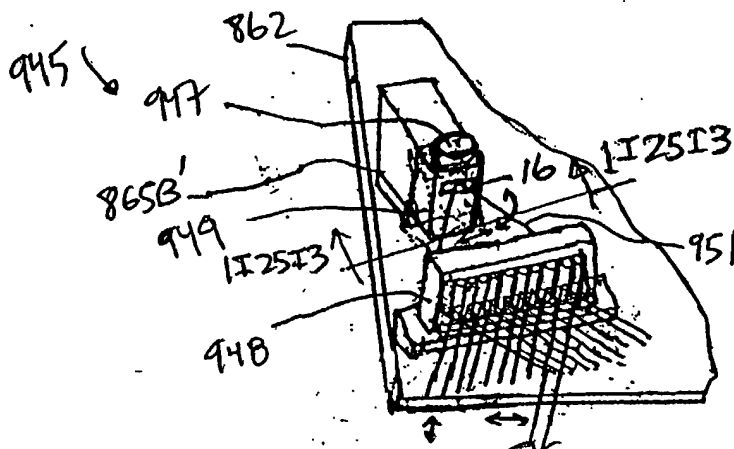


FIG. 1I25I2

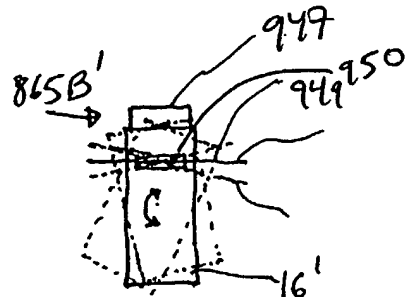


FIG. 1I25I3

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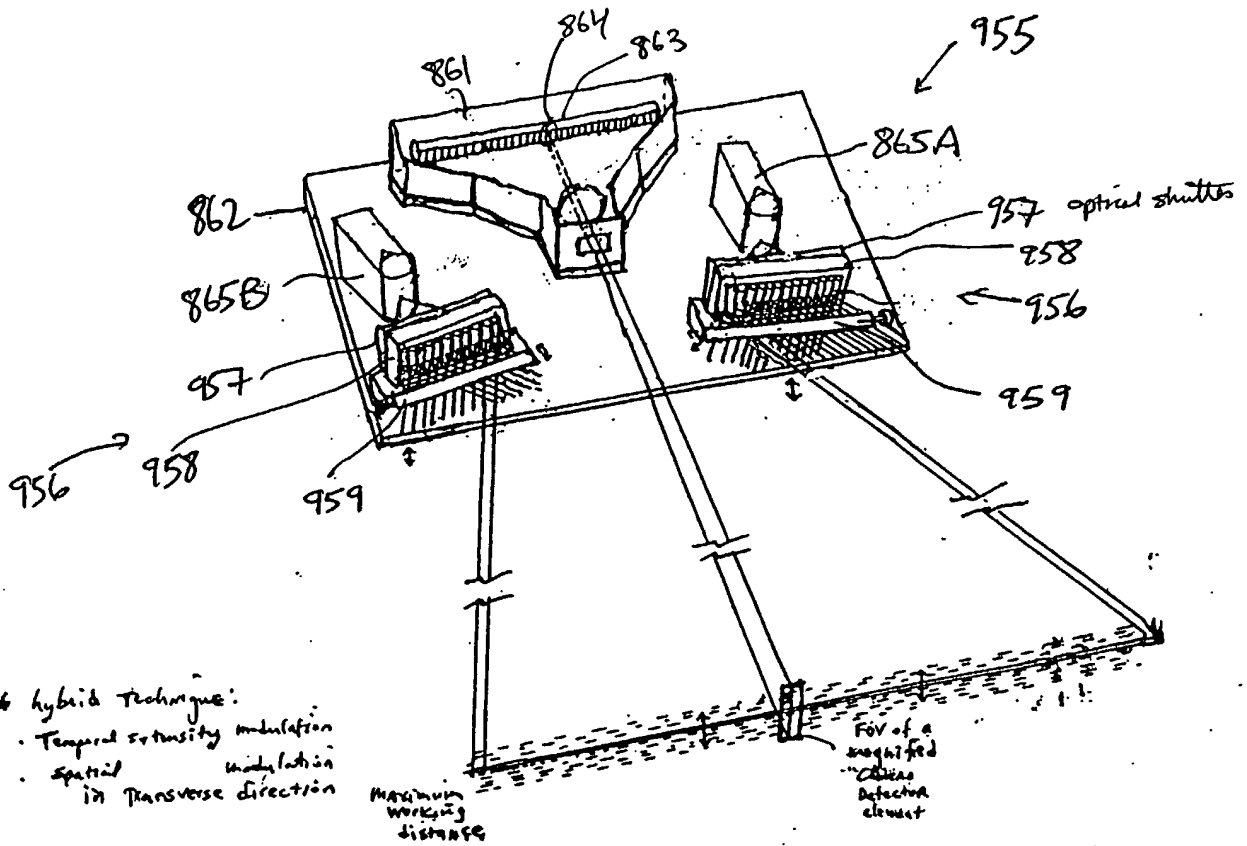


FIG. 1I25J1

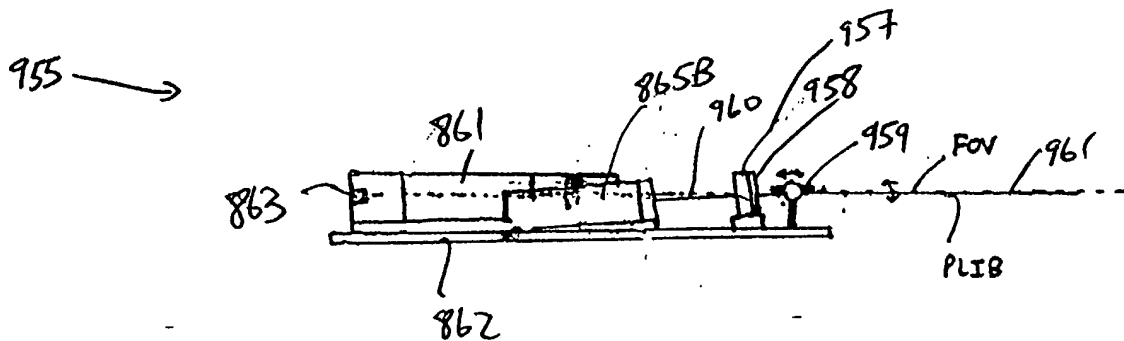


FIG. 1I25J2

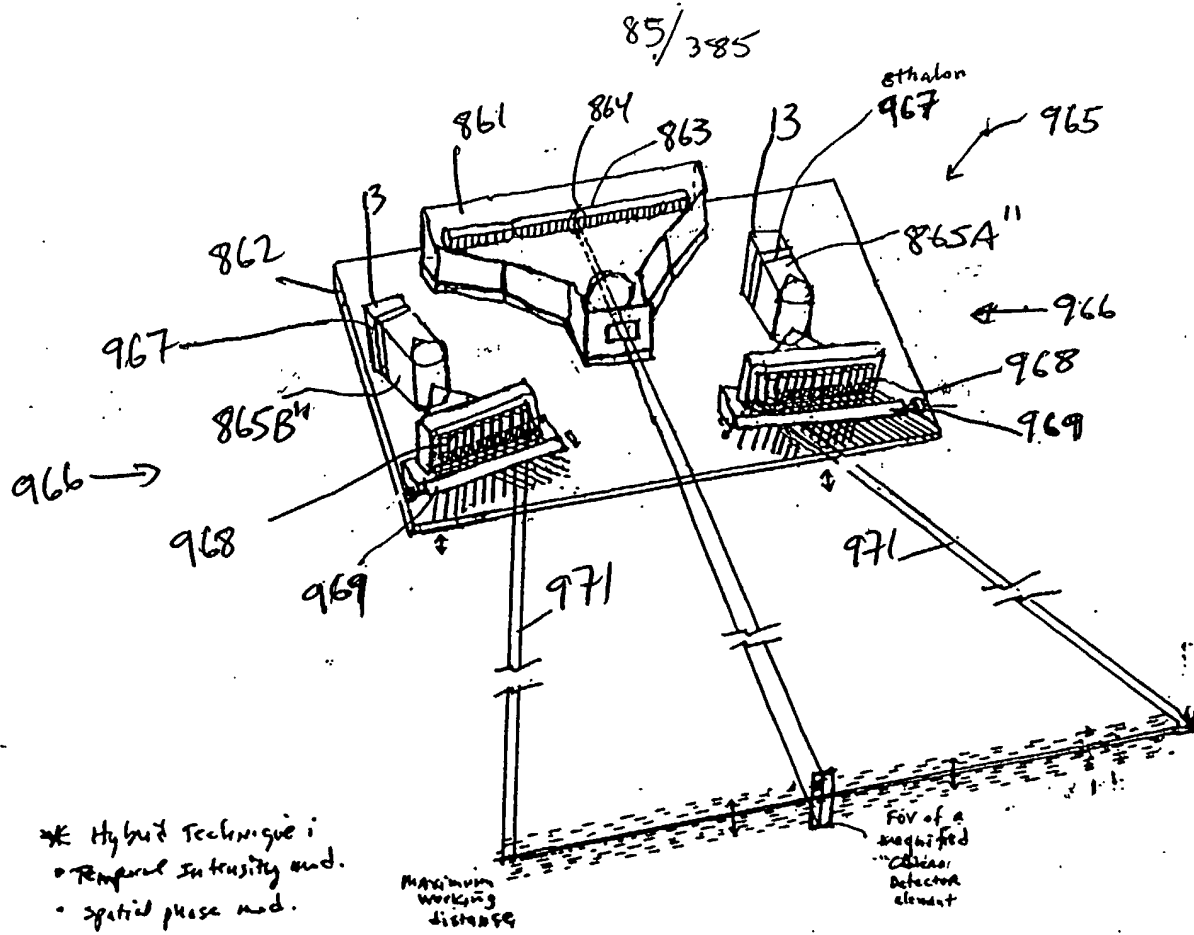


FIG. 1I25K1

* Transverse
Modulation of PLIB
965

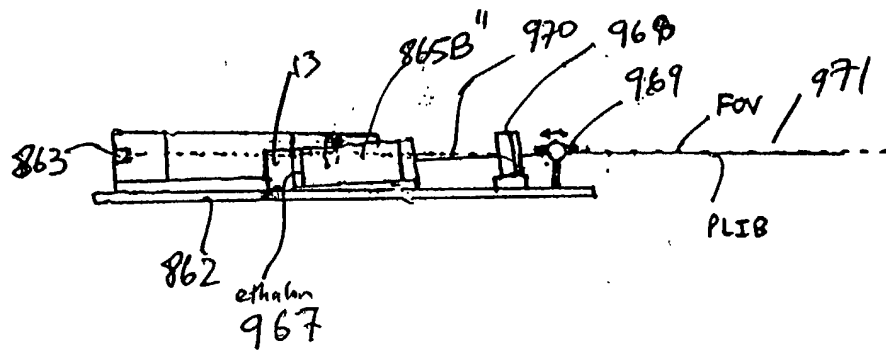
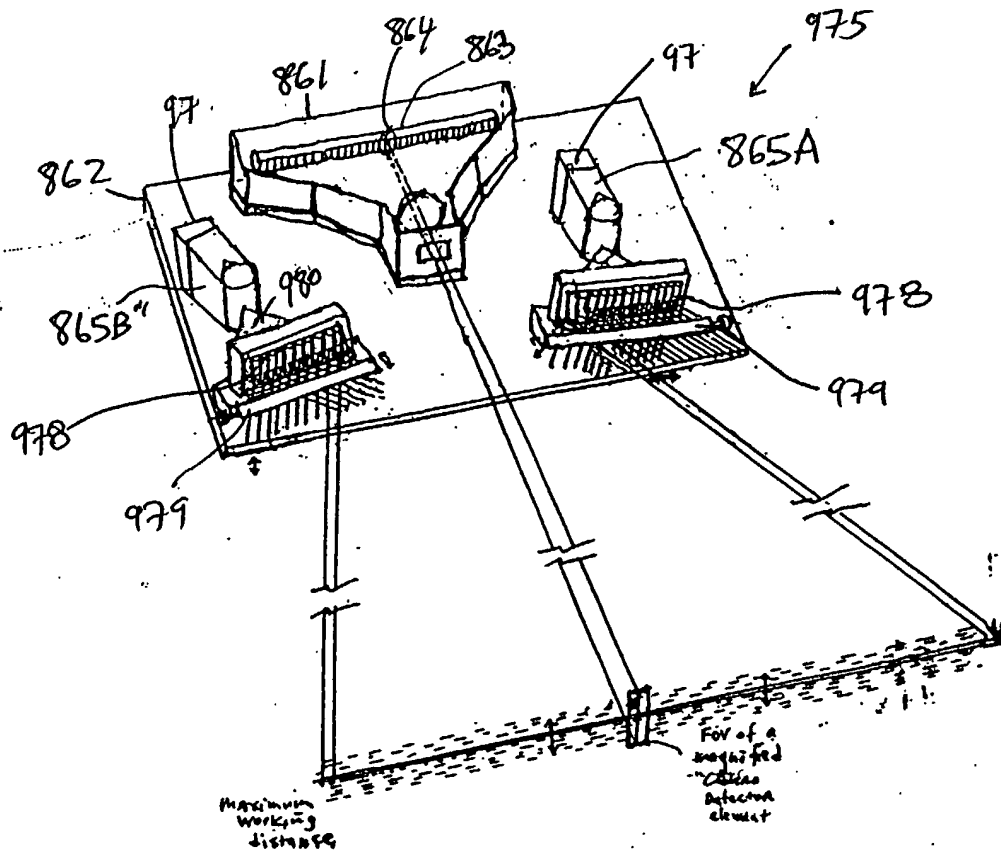


FIG. 1I25K2

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- * hybrid =
 - Temp. freq. mod.
 - Spatial phase mod.
- * Transverse microoscillation of PLIB

FIG. 1I25L1

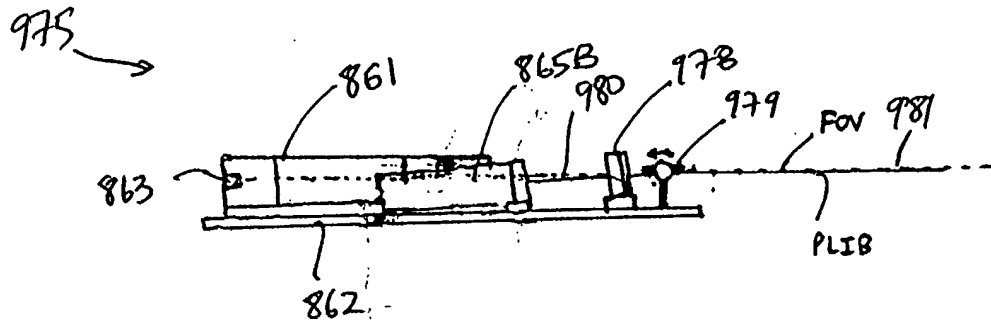


FIG. 1I25L2

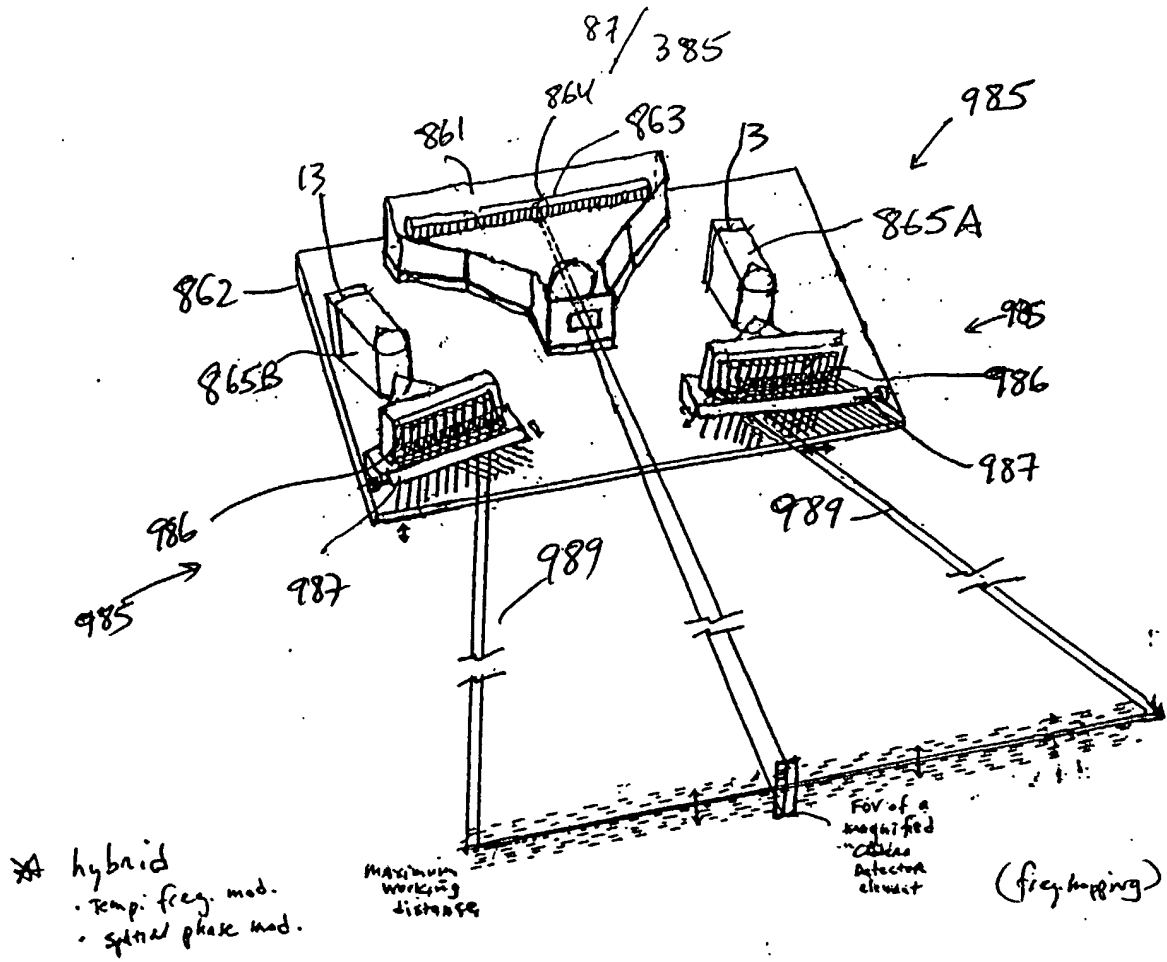


FIG. 1I25M1

* Transverse
Microoscillation of PLIB

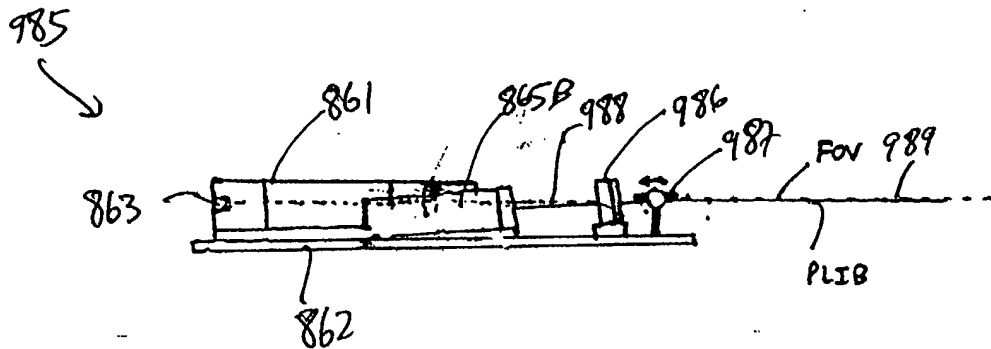
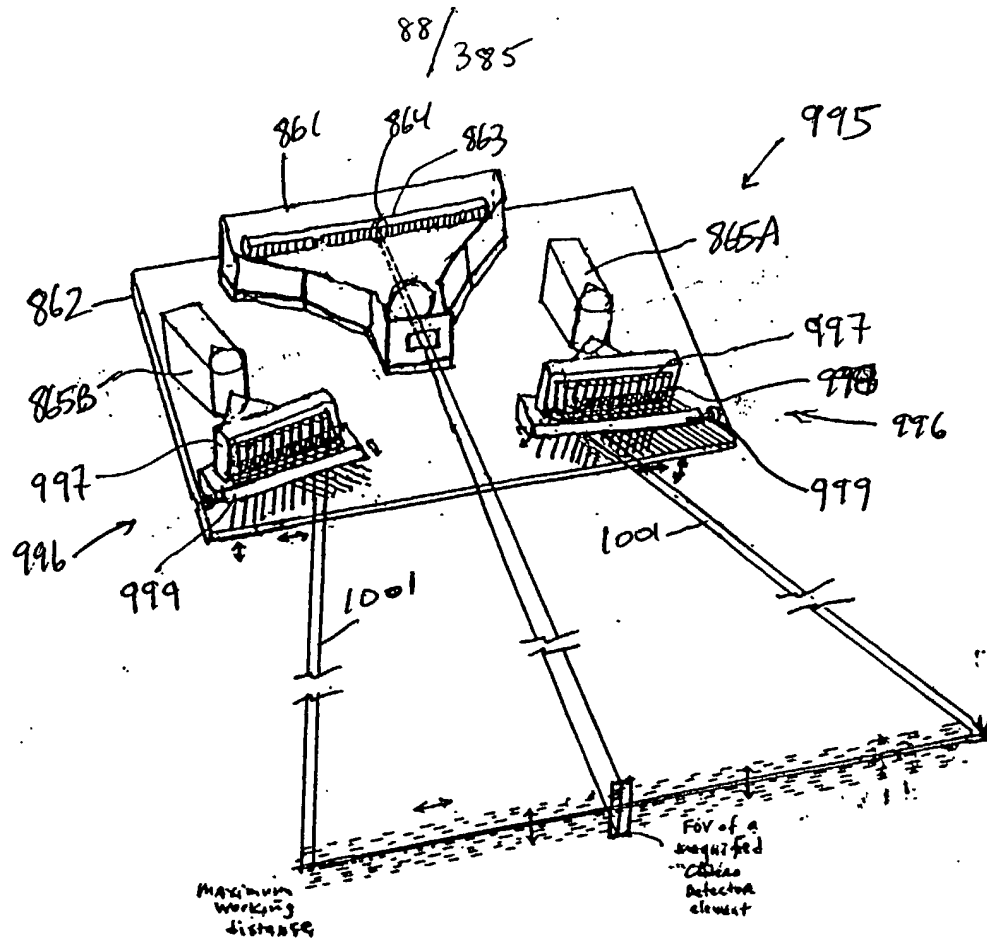


FIG. 1I25M2



- * hybrid:
 - spatial intensity mod.
 - spatial phase
- * lateral and transverse resolution of PLIB

FIG. 1I25N1

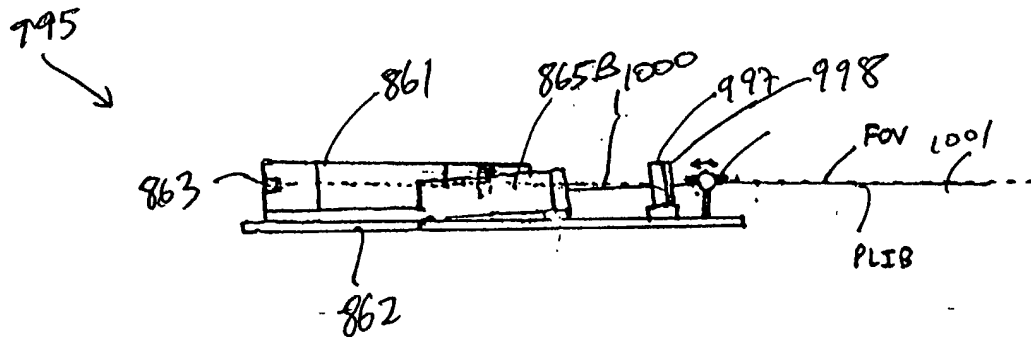


FIG. 1I25NZ

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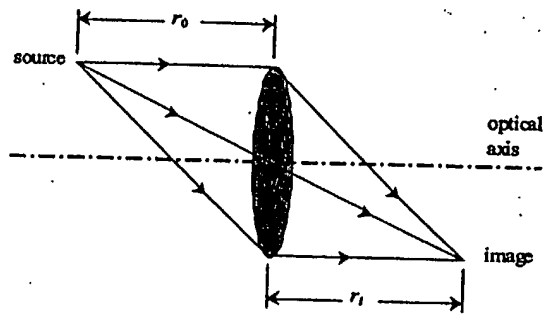


FIG. 1H1

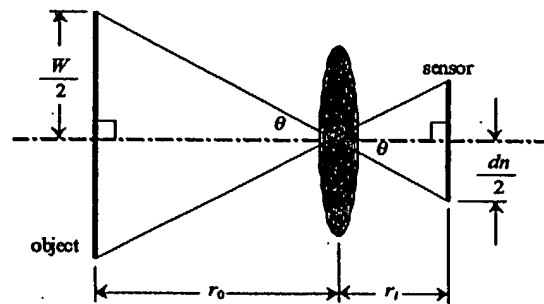


FIG. 1H2

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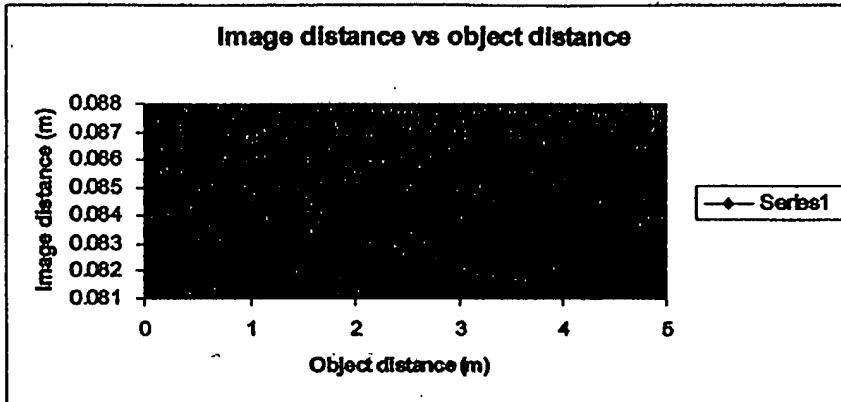


FIG. 1H3

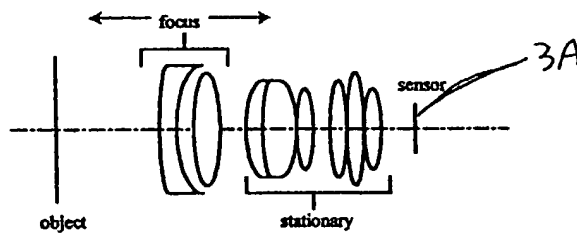


FIG. 1H4

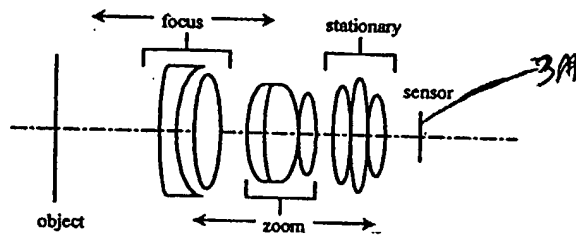


FIG. 1H5

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Fixed focal length lens cases

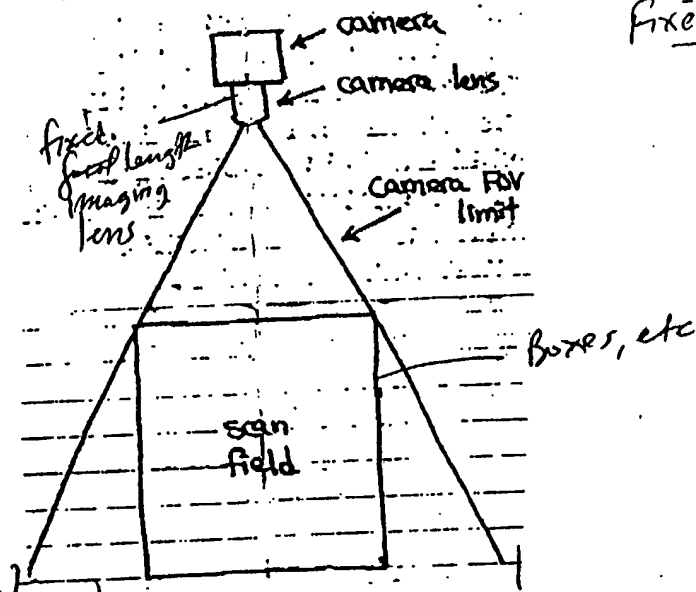


FIG. 1K1
converger 34

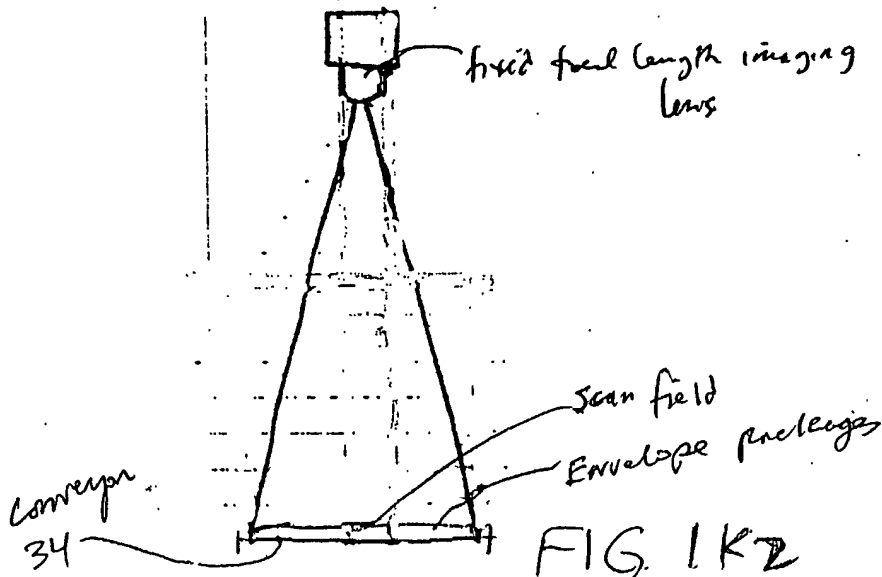
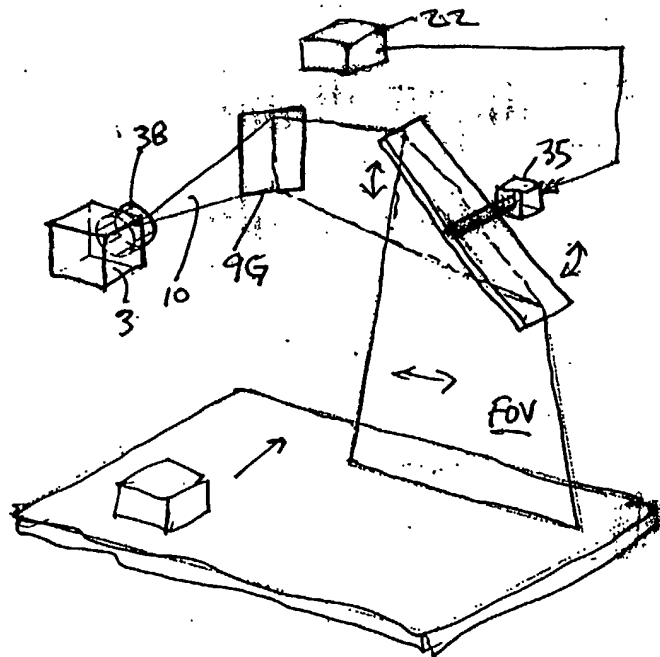
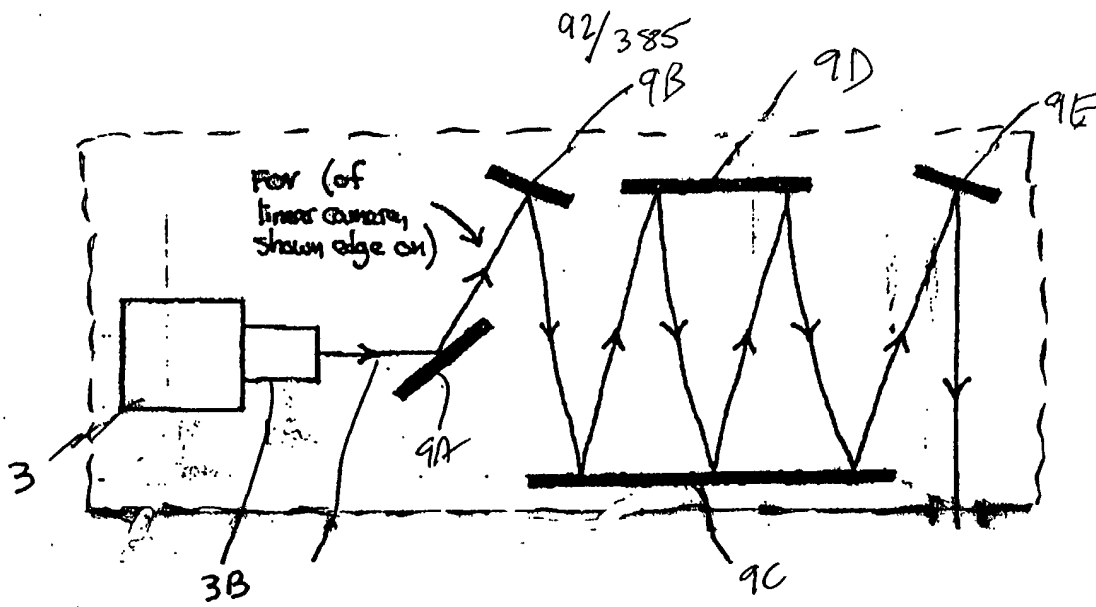


FIG. 1K2



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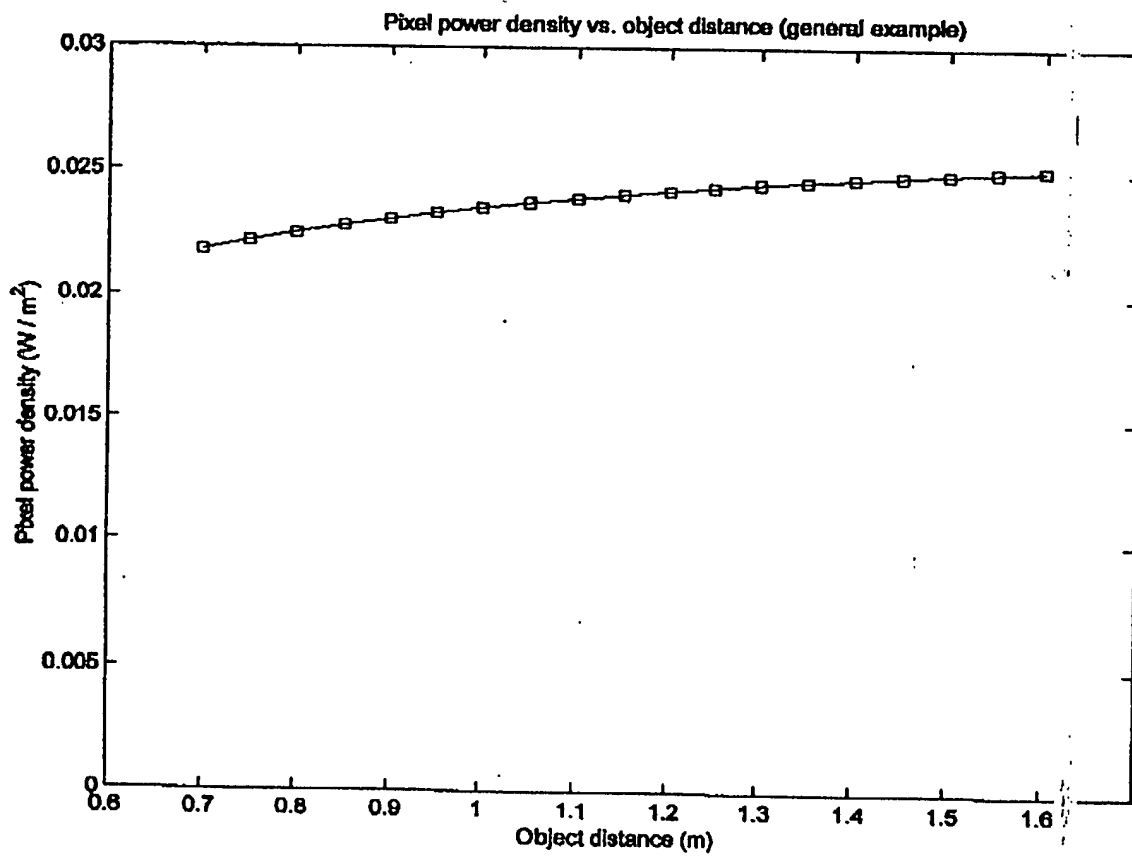


FIG-1M1

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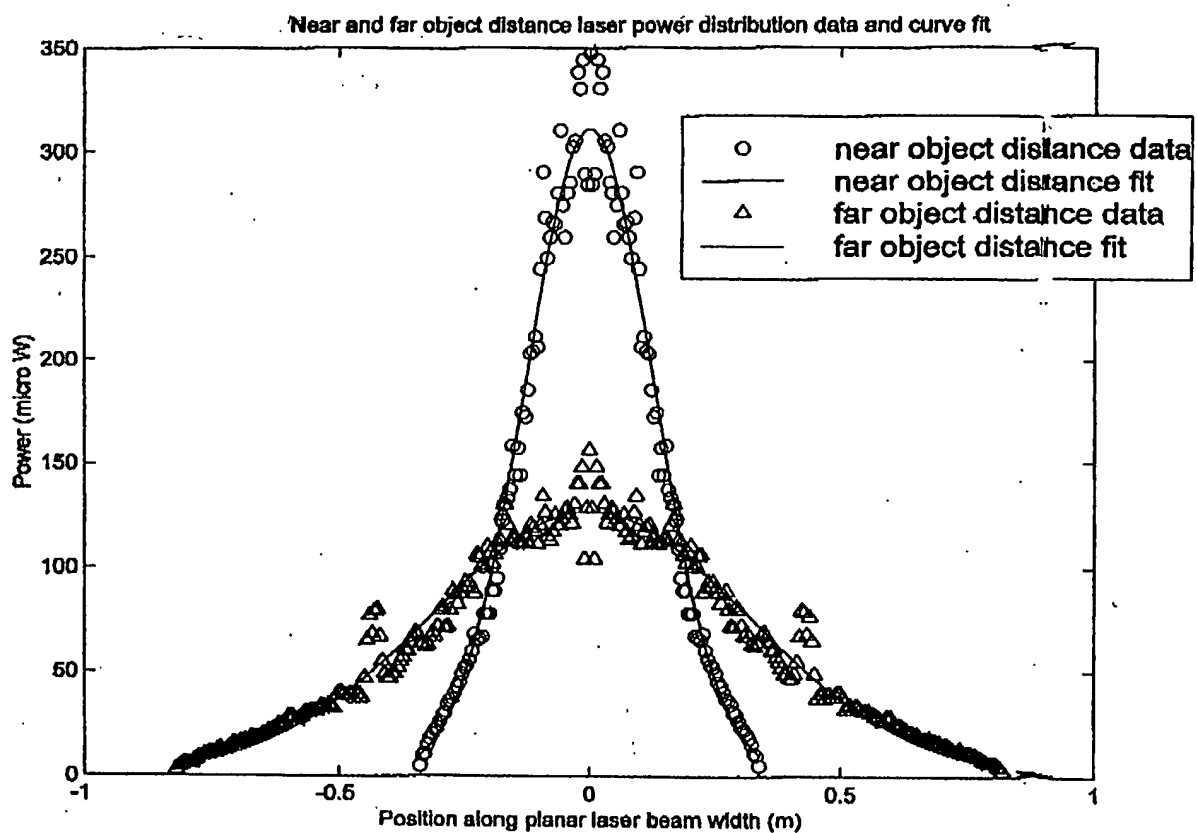


FIG. 1M2

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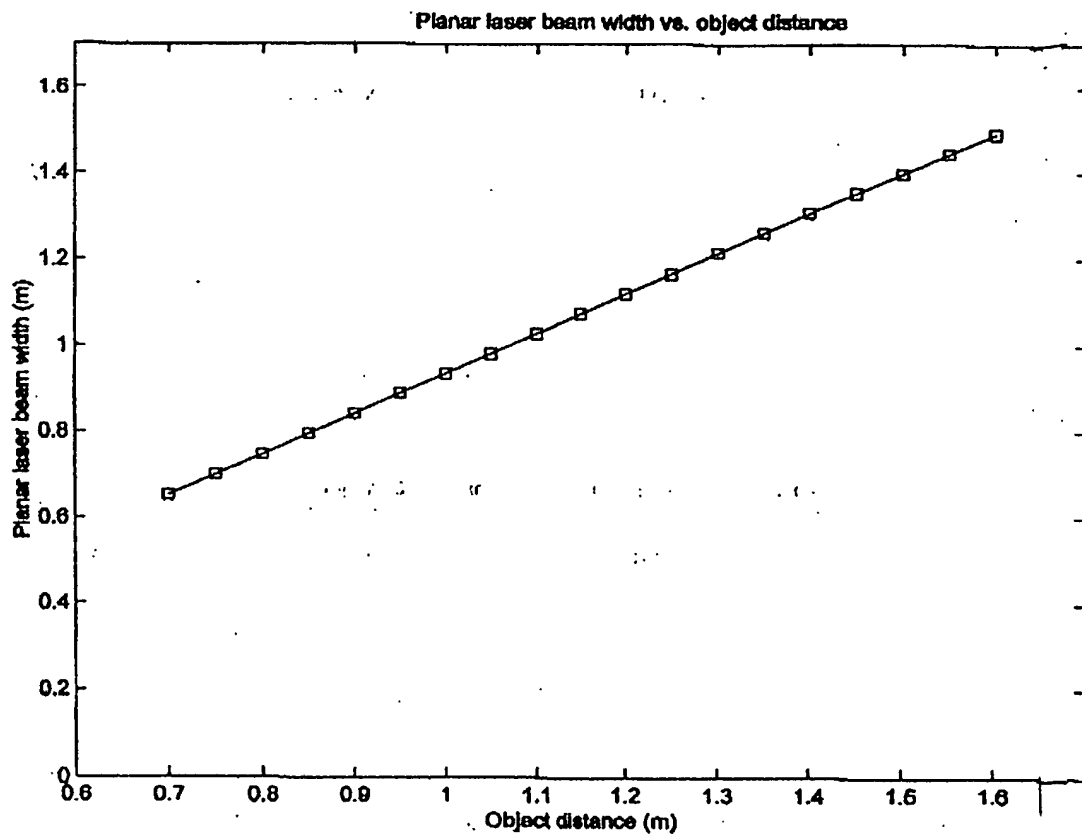


FIG. 1M3

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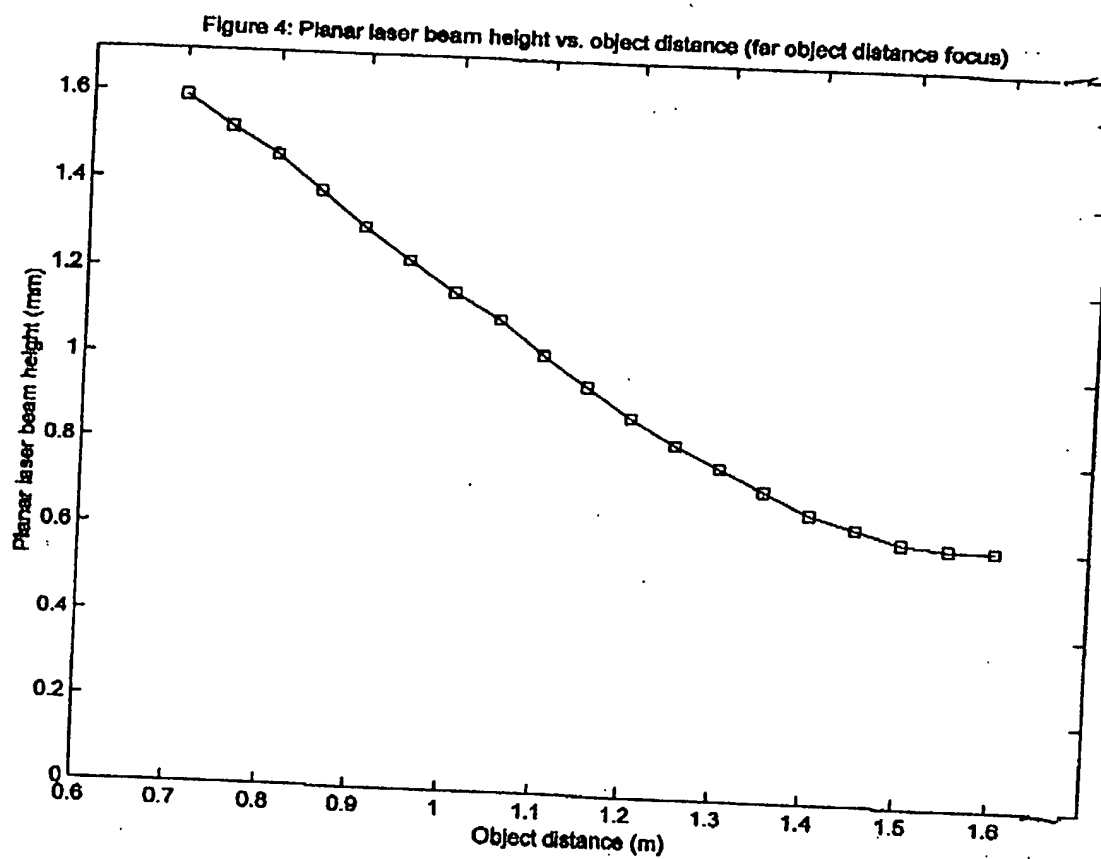


FIG. 1M4

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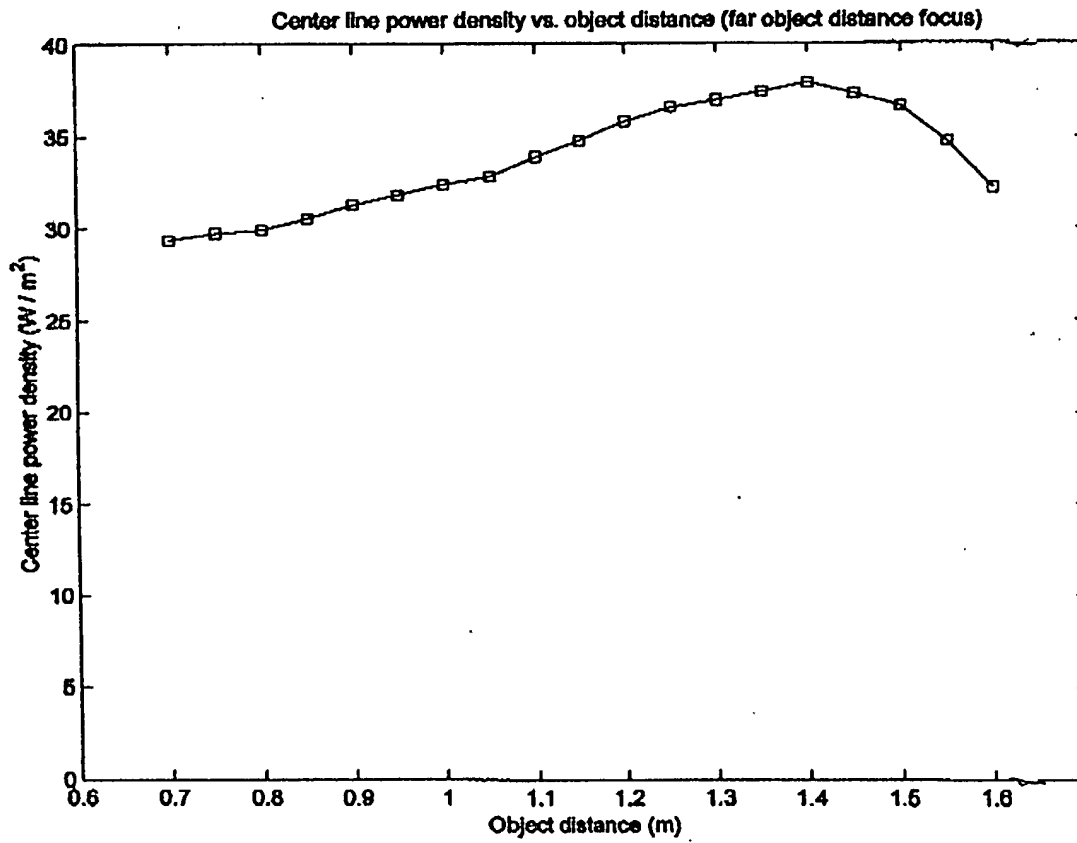


FIG. 1N

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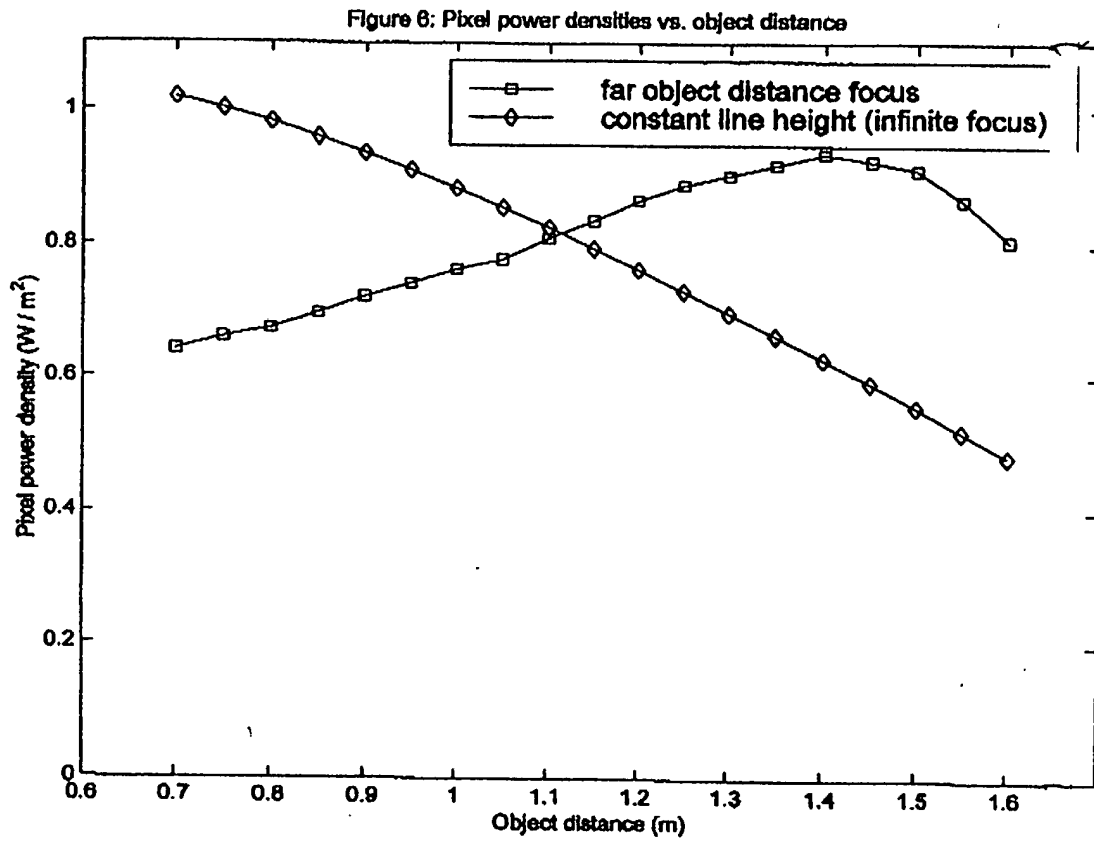
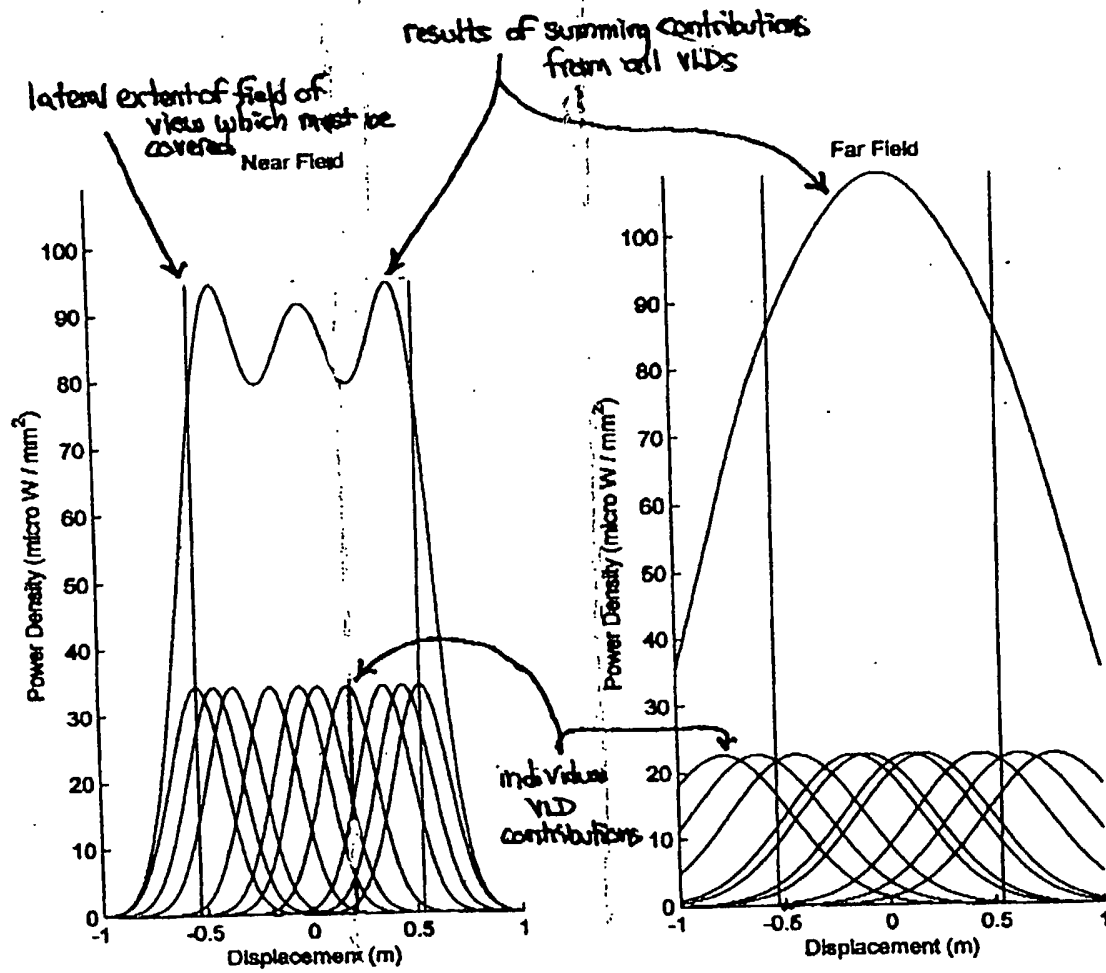


FIG. 10

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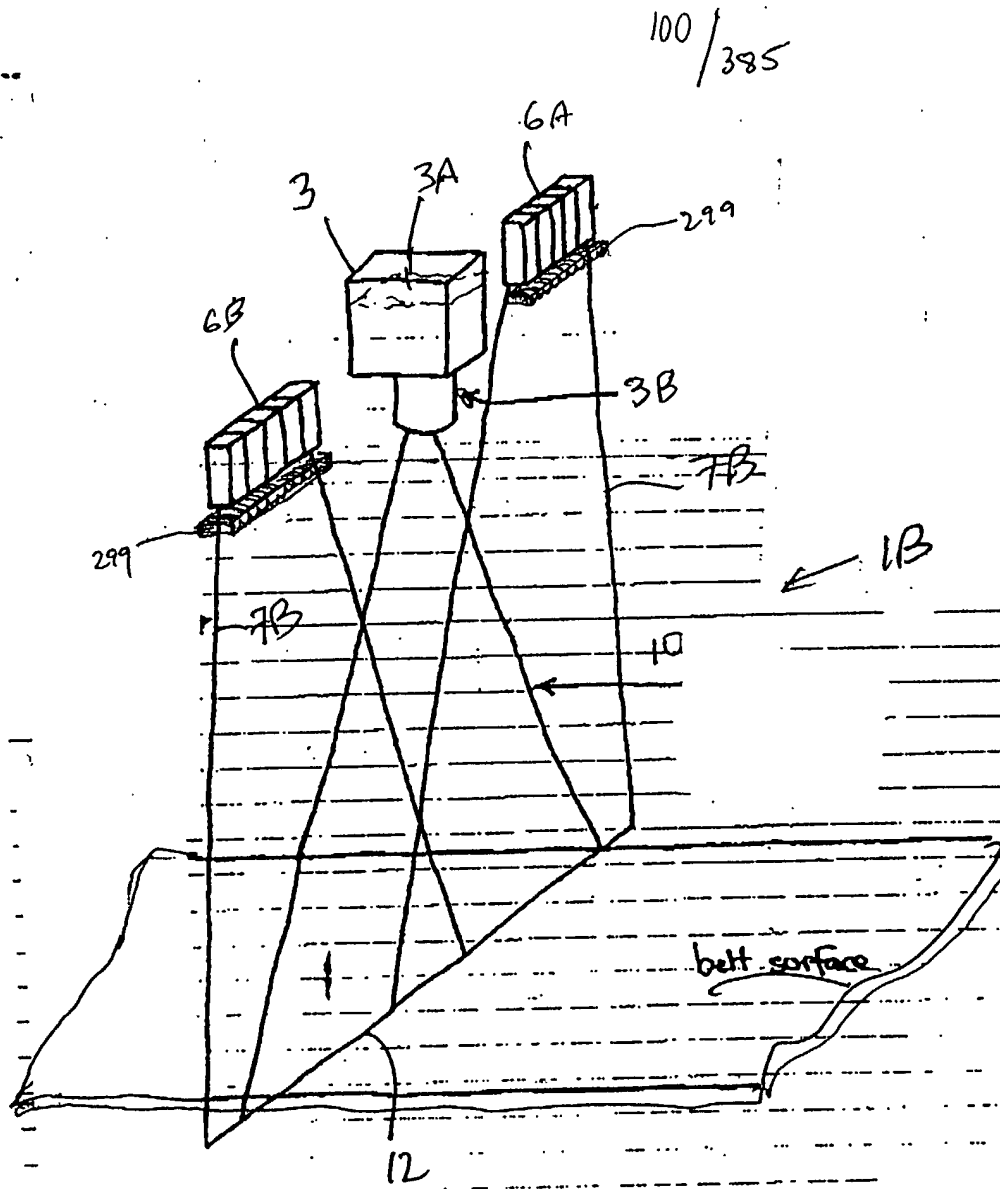


FIG. 101

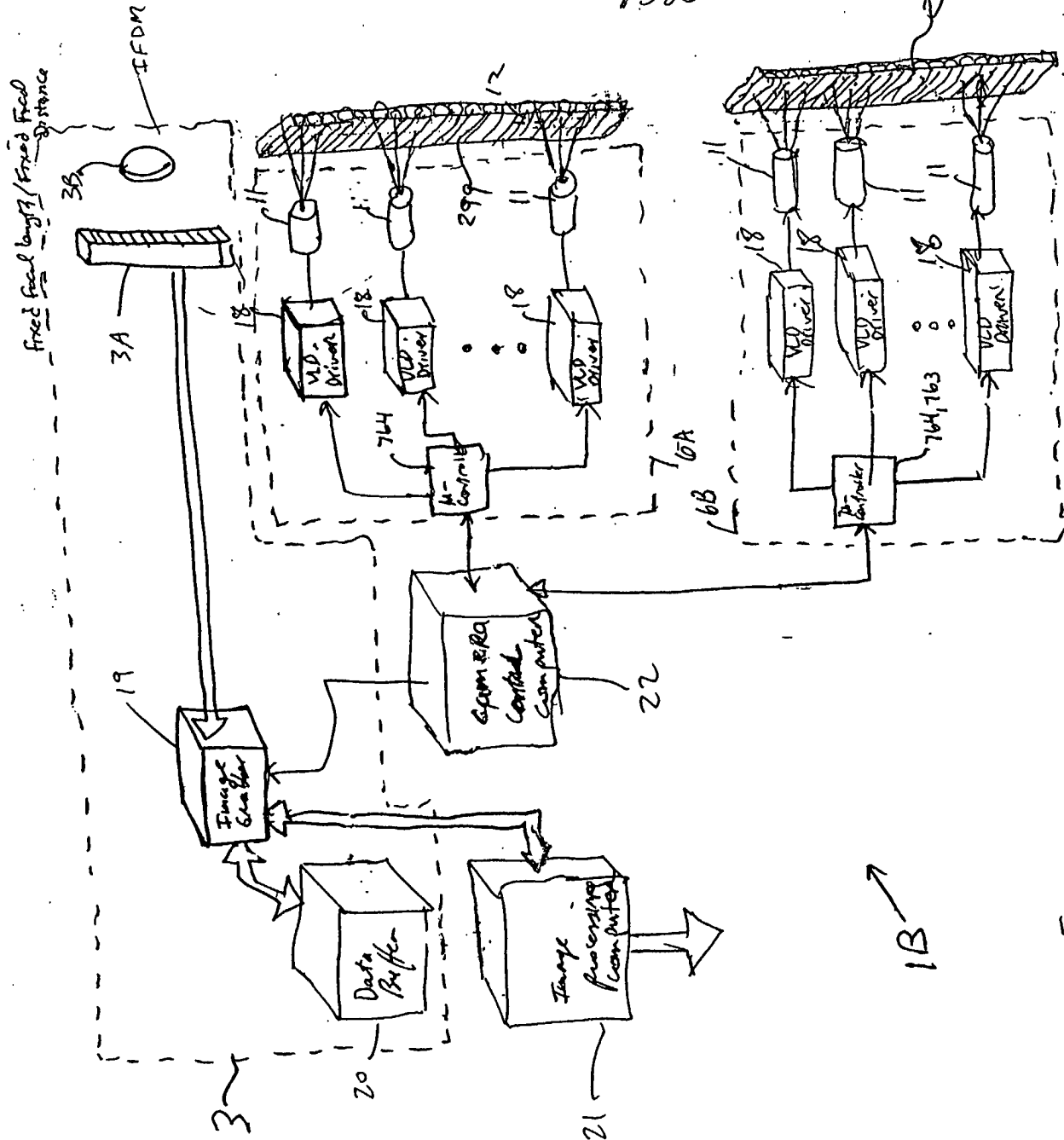
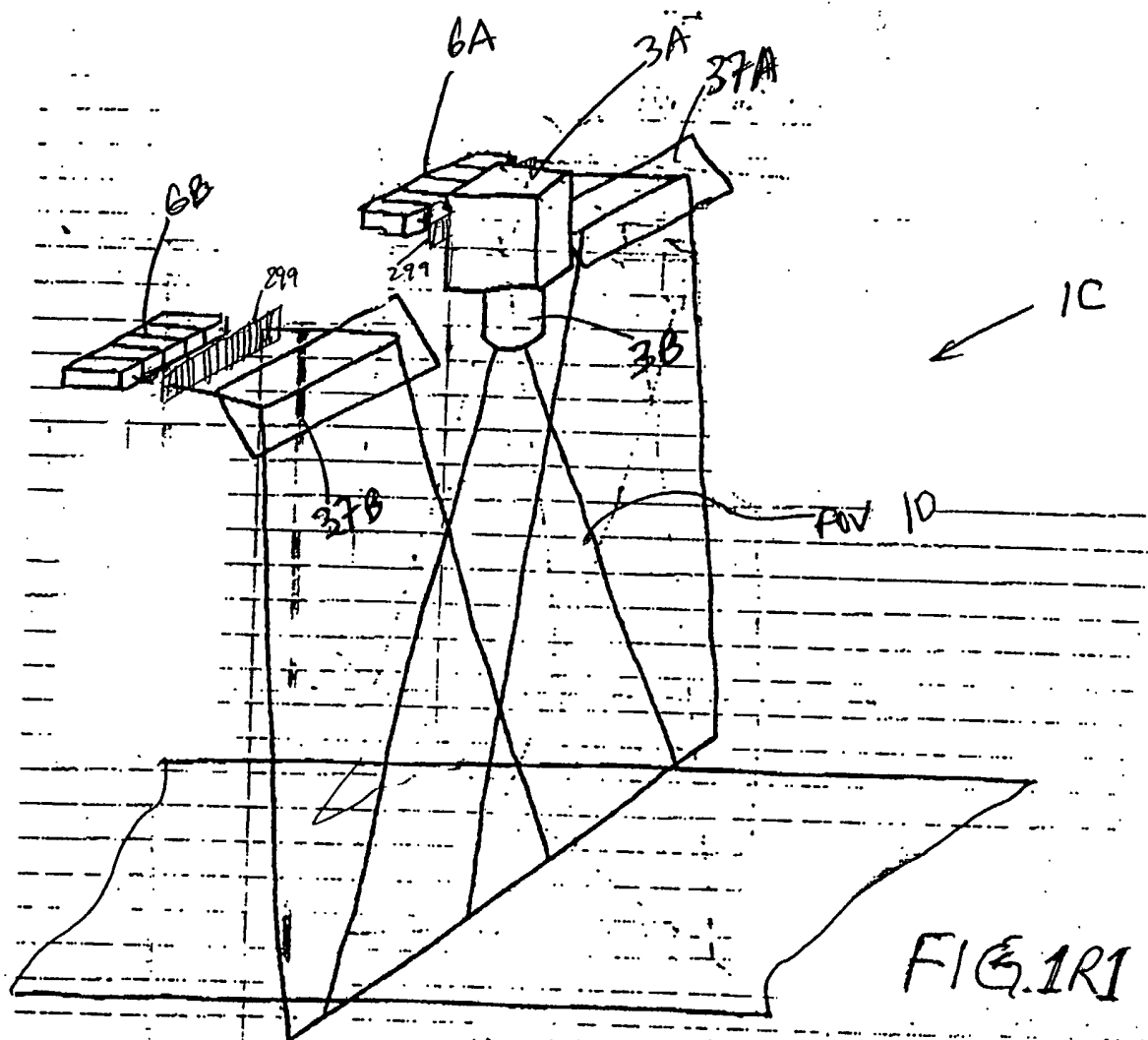
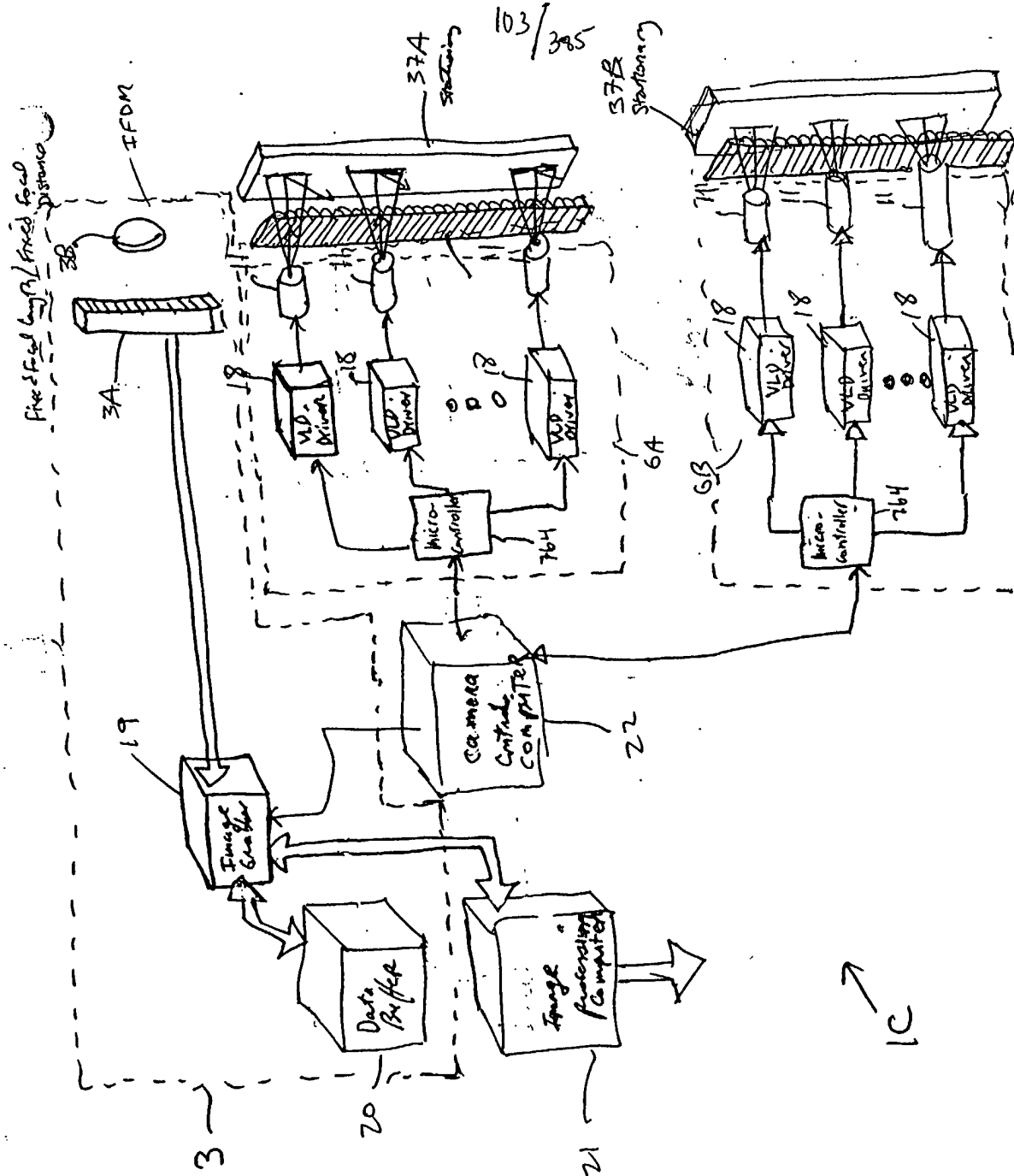
$$101/385$$


FIG. 102

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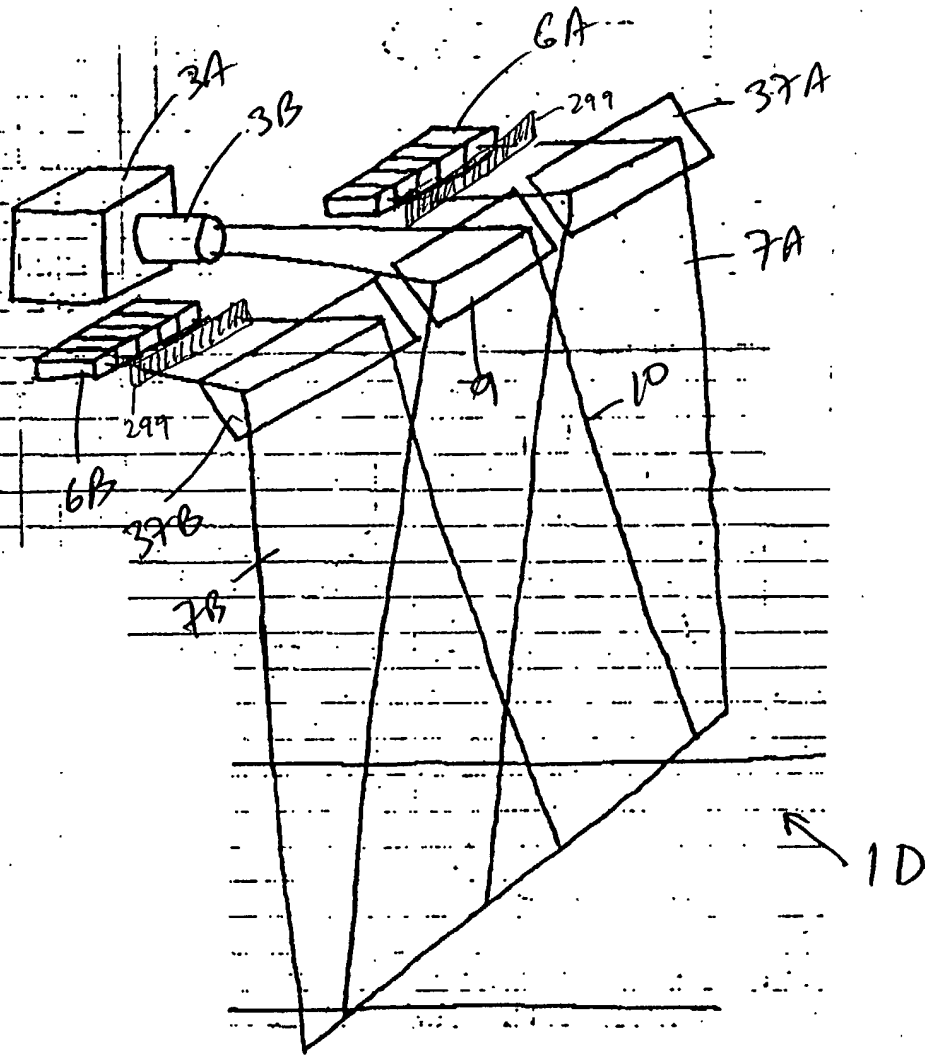


FIG. 1S1

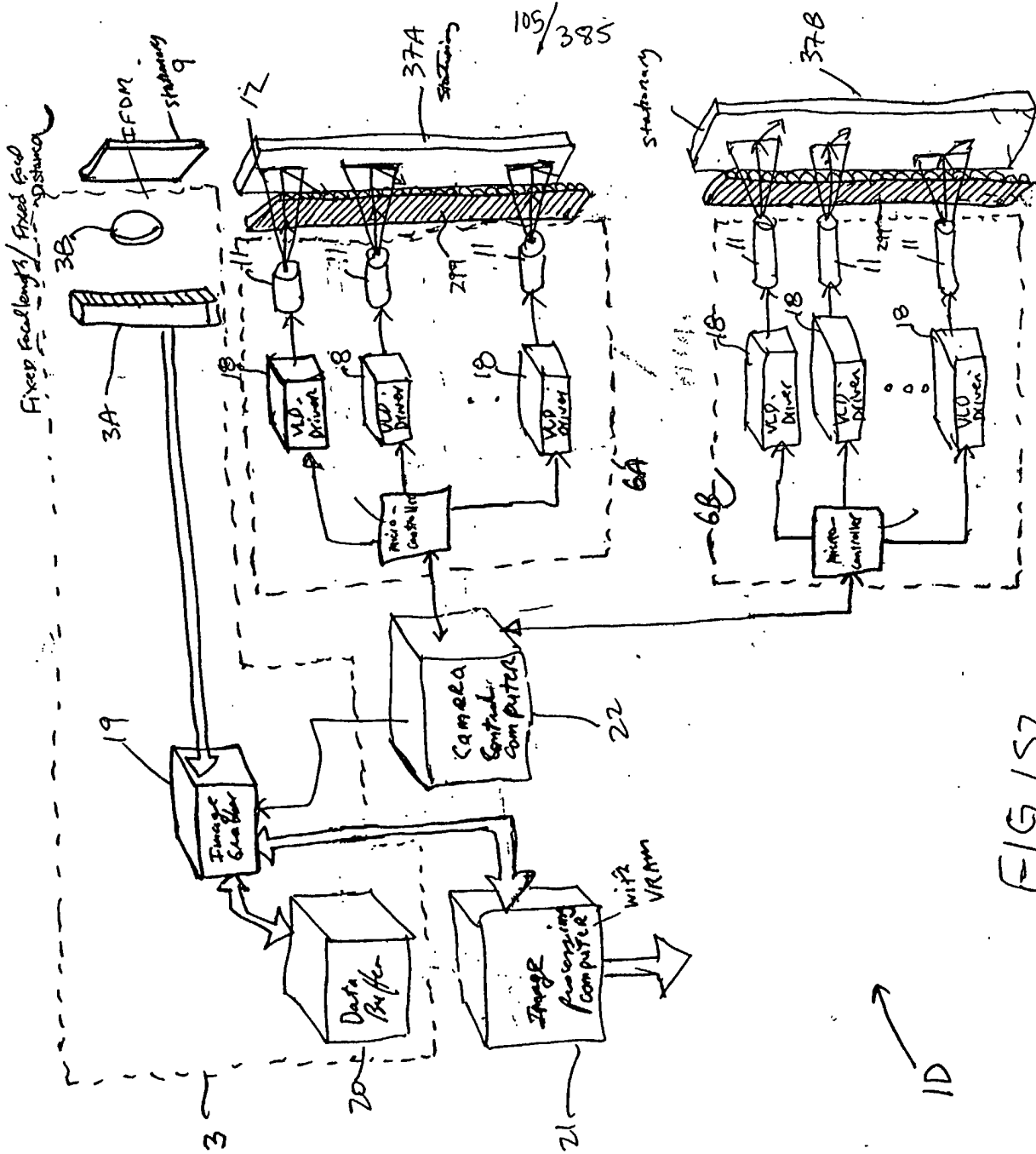


FIG. 152

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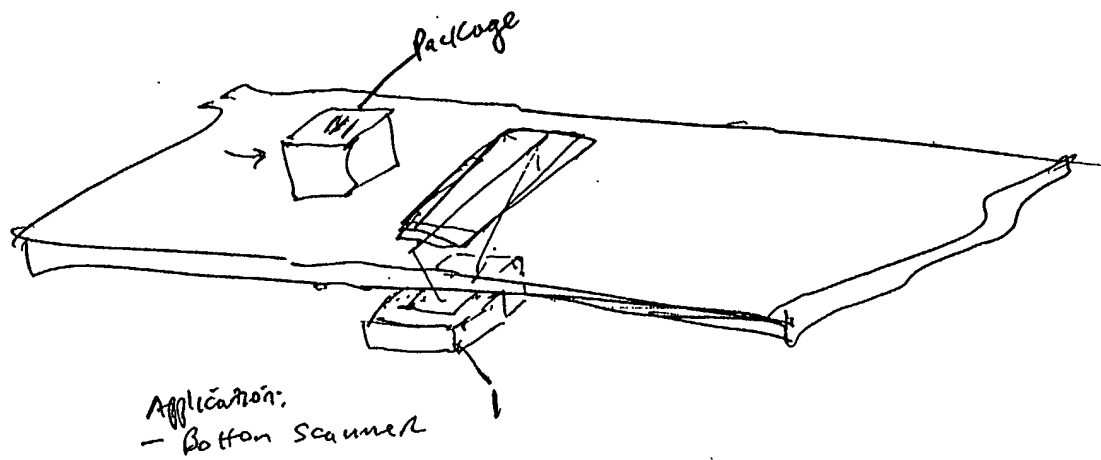
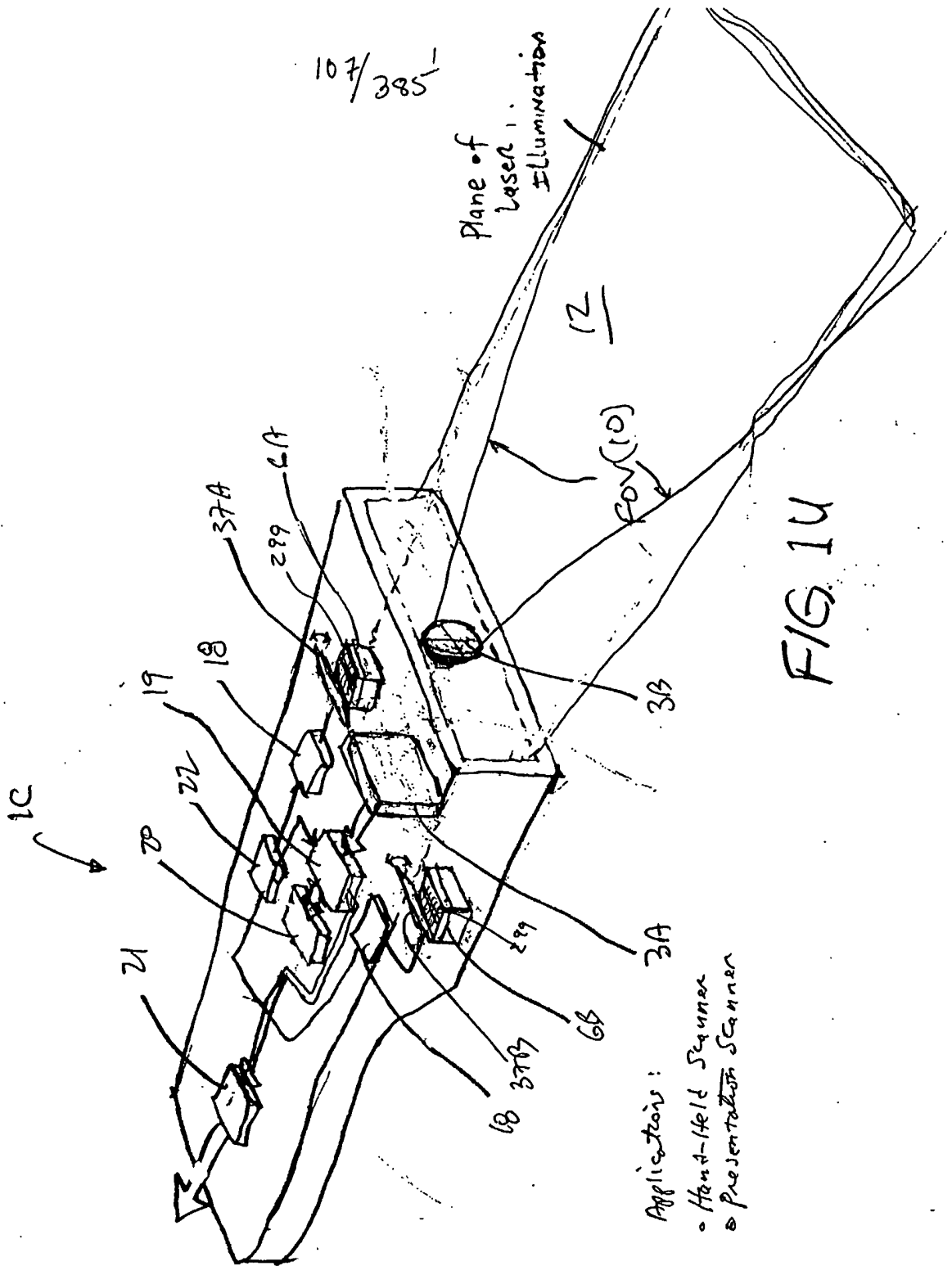


FIG 1T



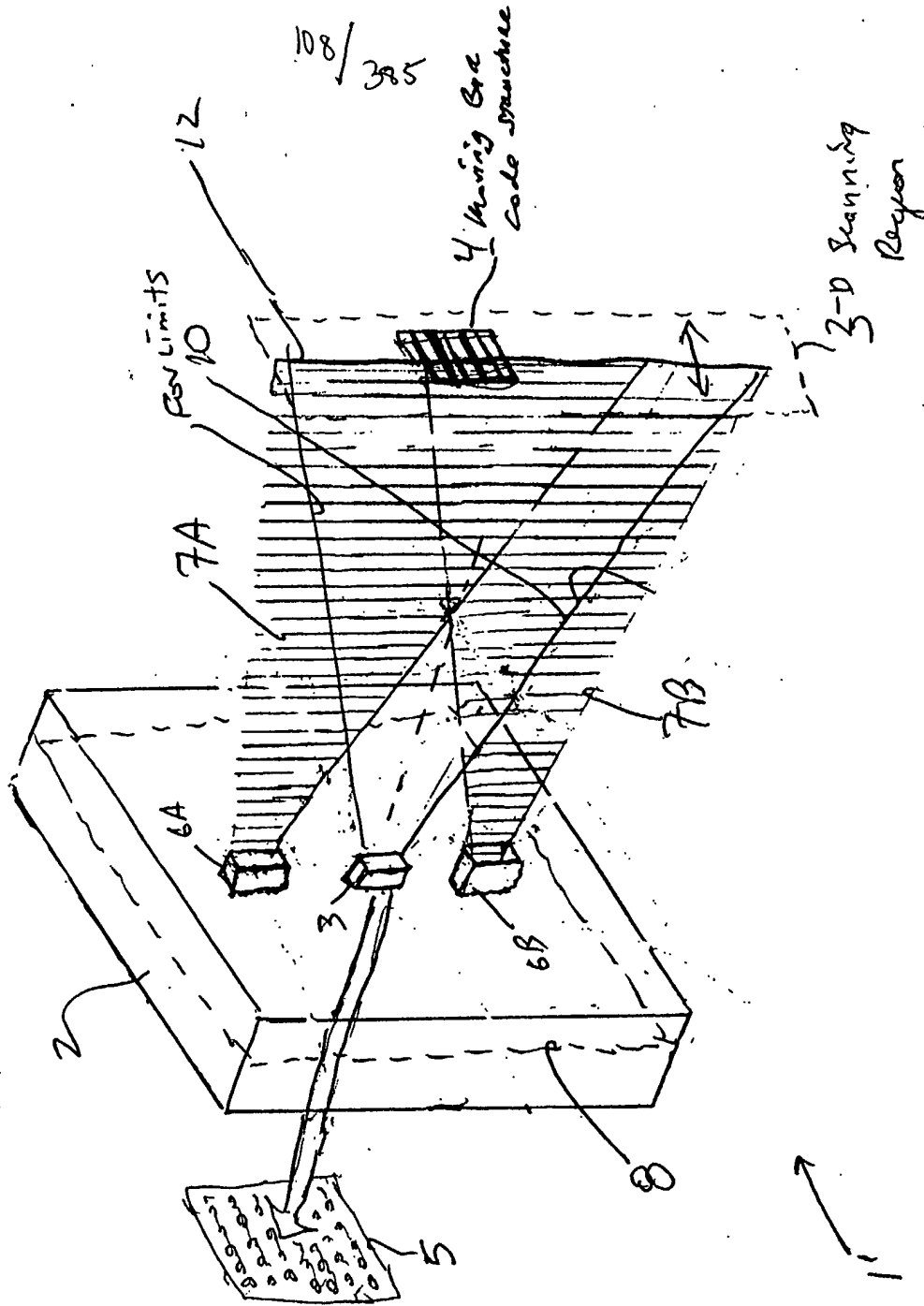


FIG. 1VI

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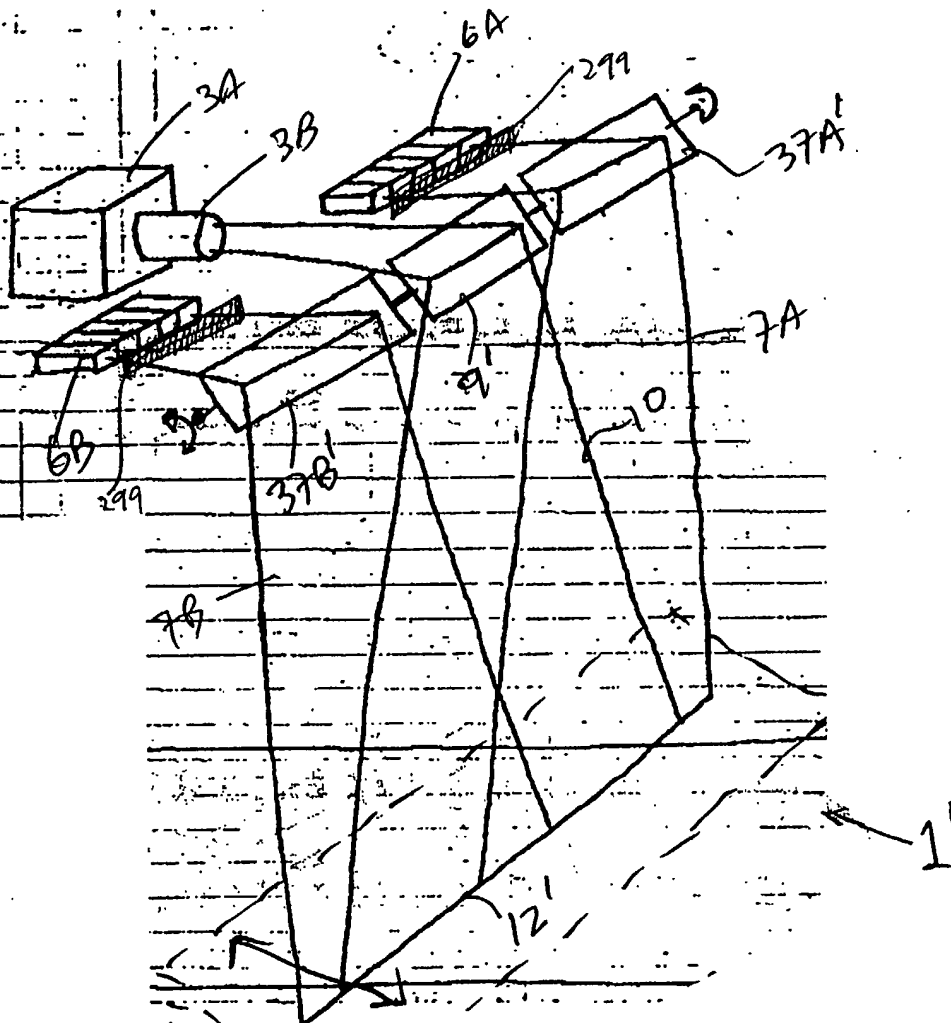


FIG. IV2

2-D
region
of
space

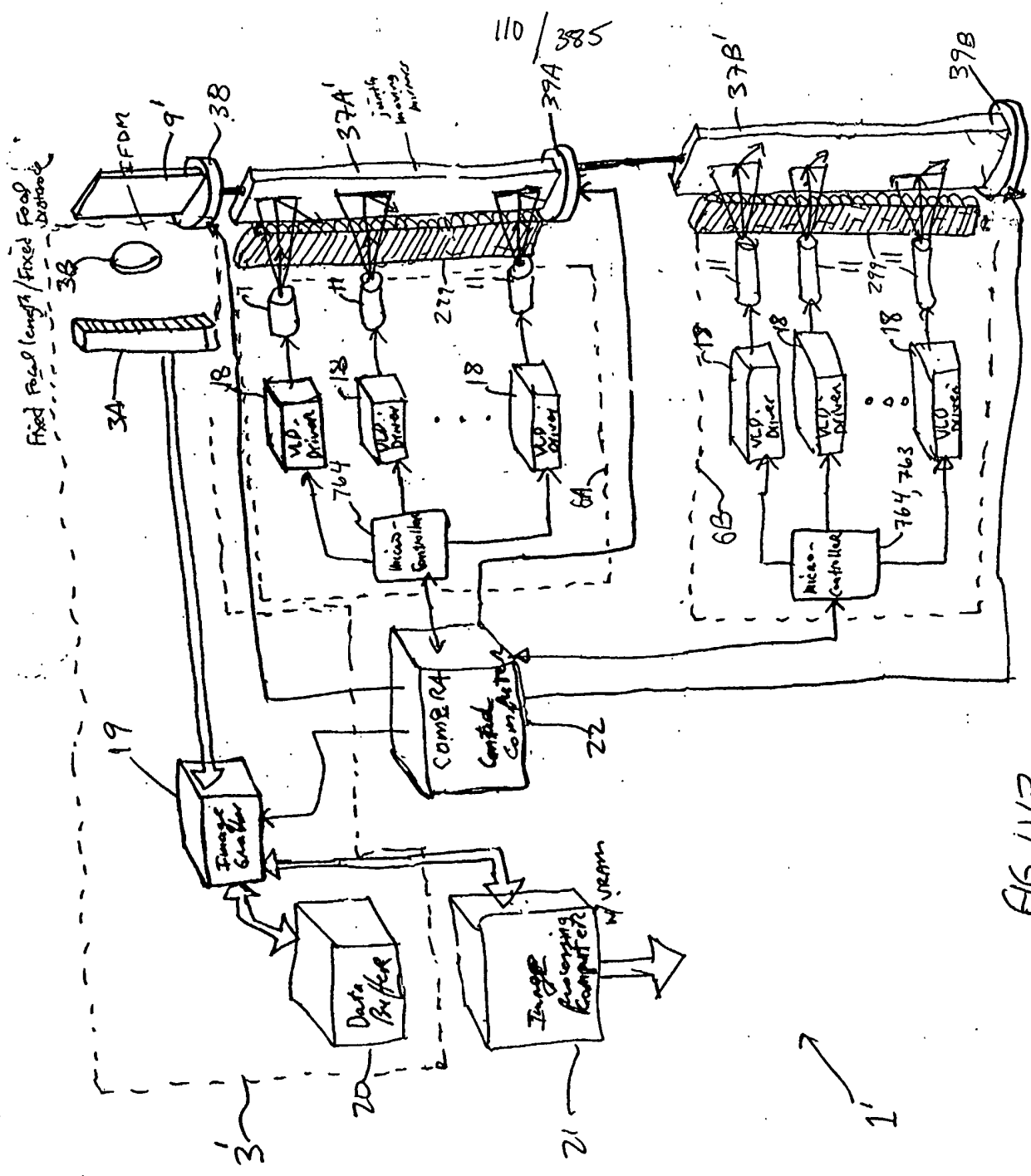


FIG. 1V3

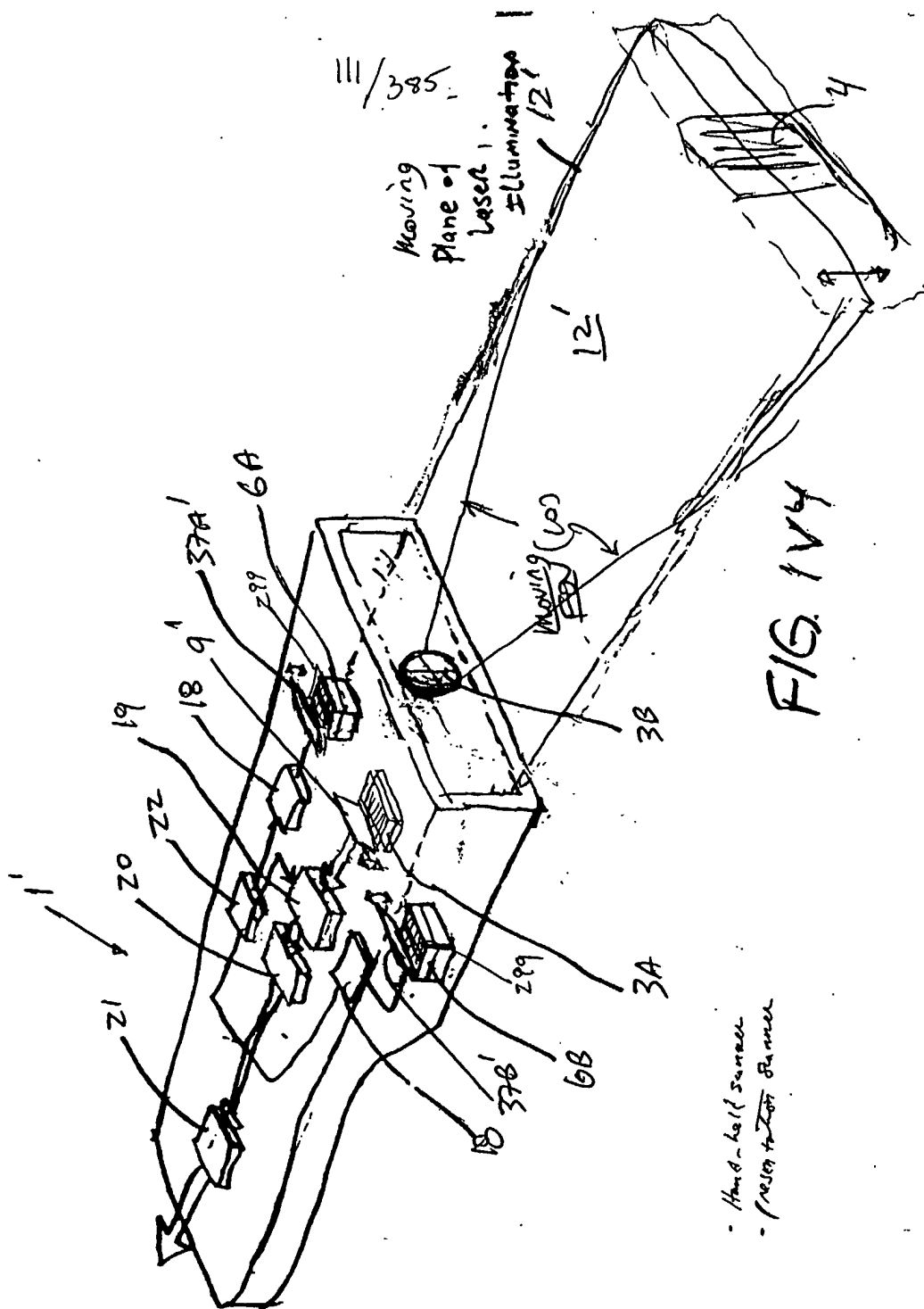


FIG. 1V4

- Hand-held Scanner
- FASCO to ZOT Banner

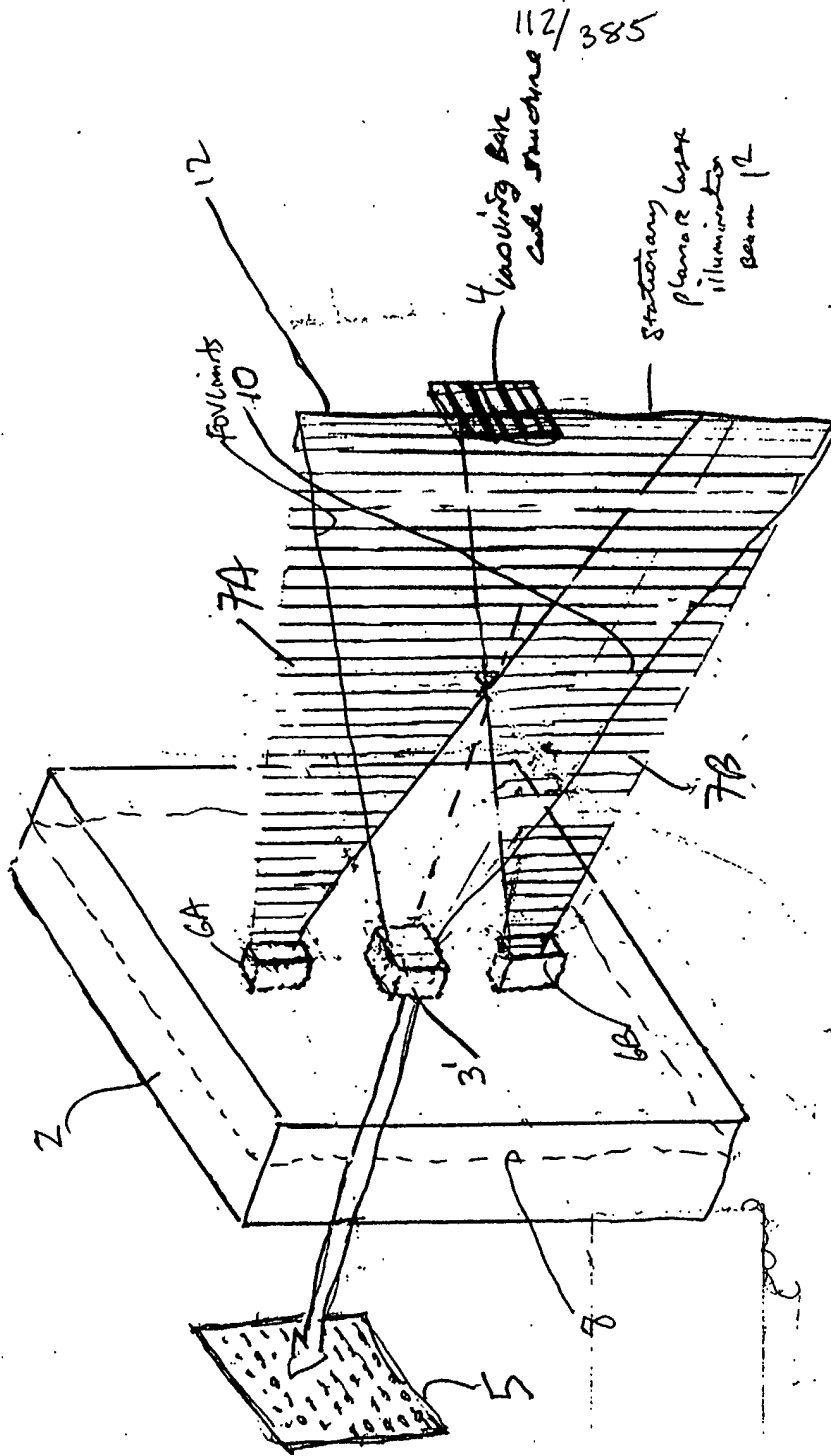


FIG. 2A

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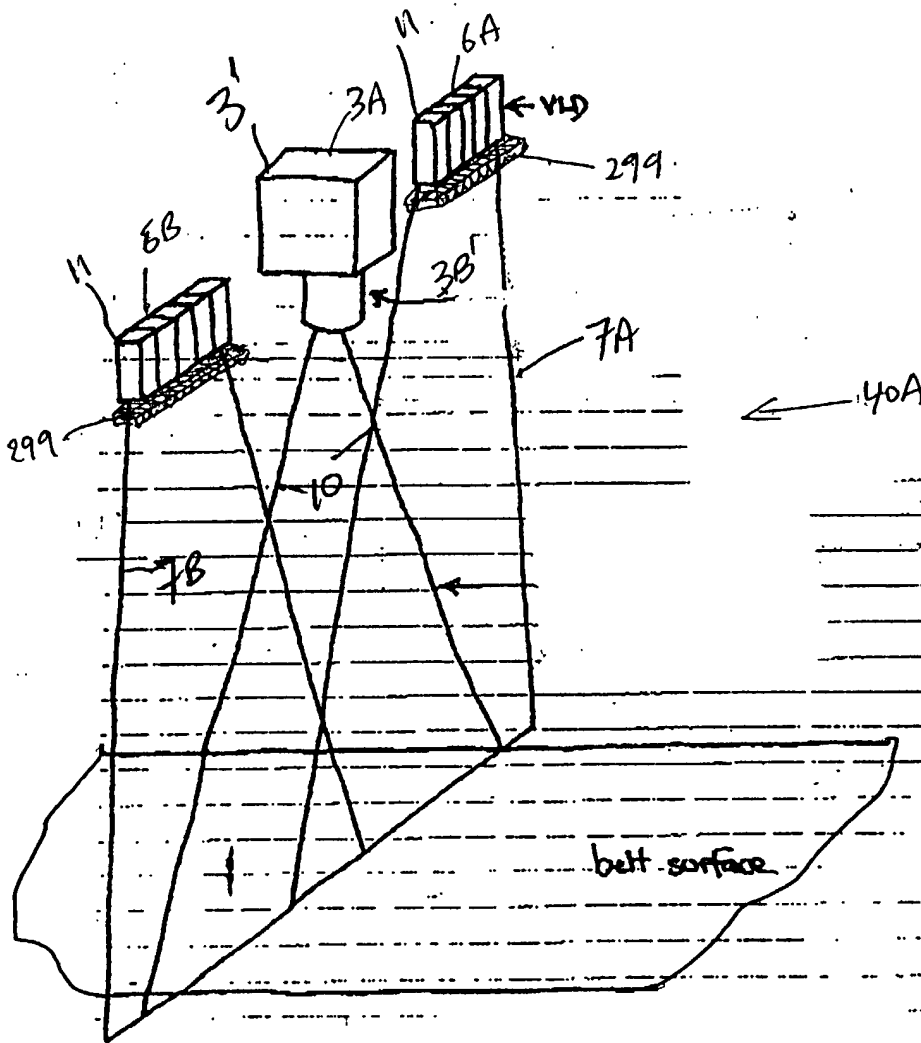


FIG. 2 B1

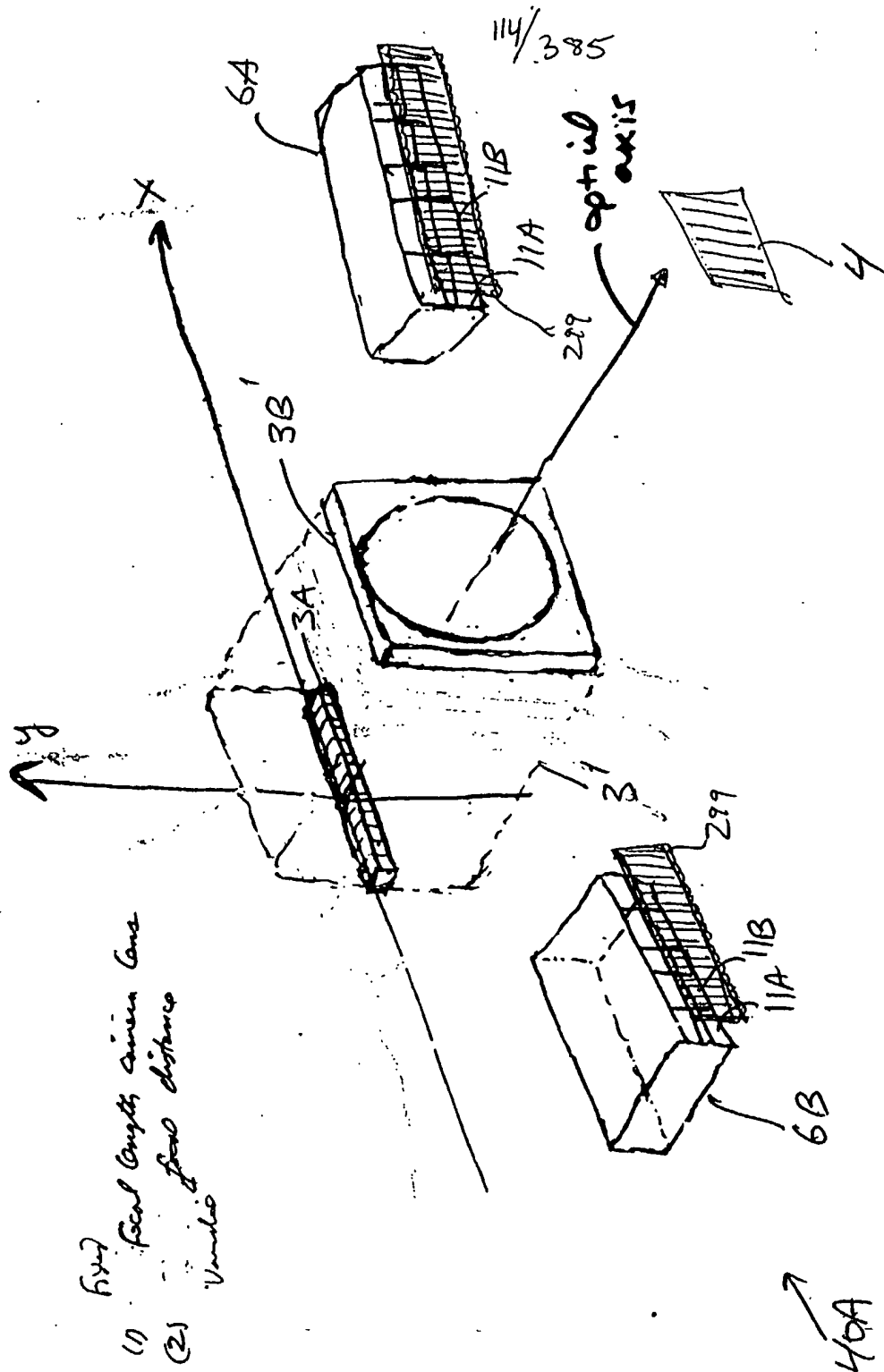
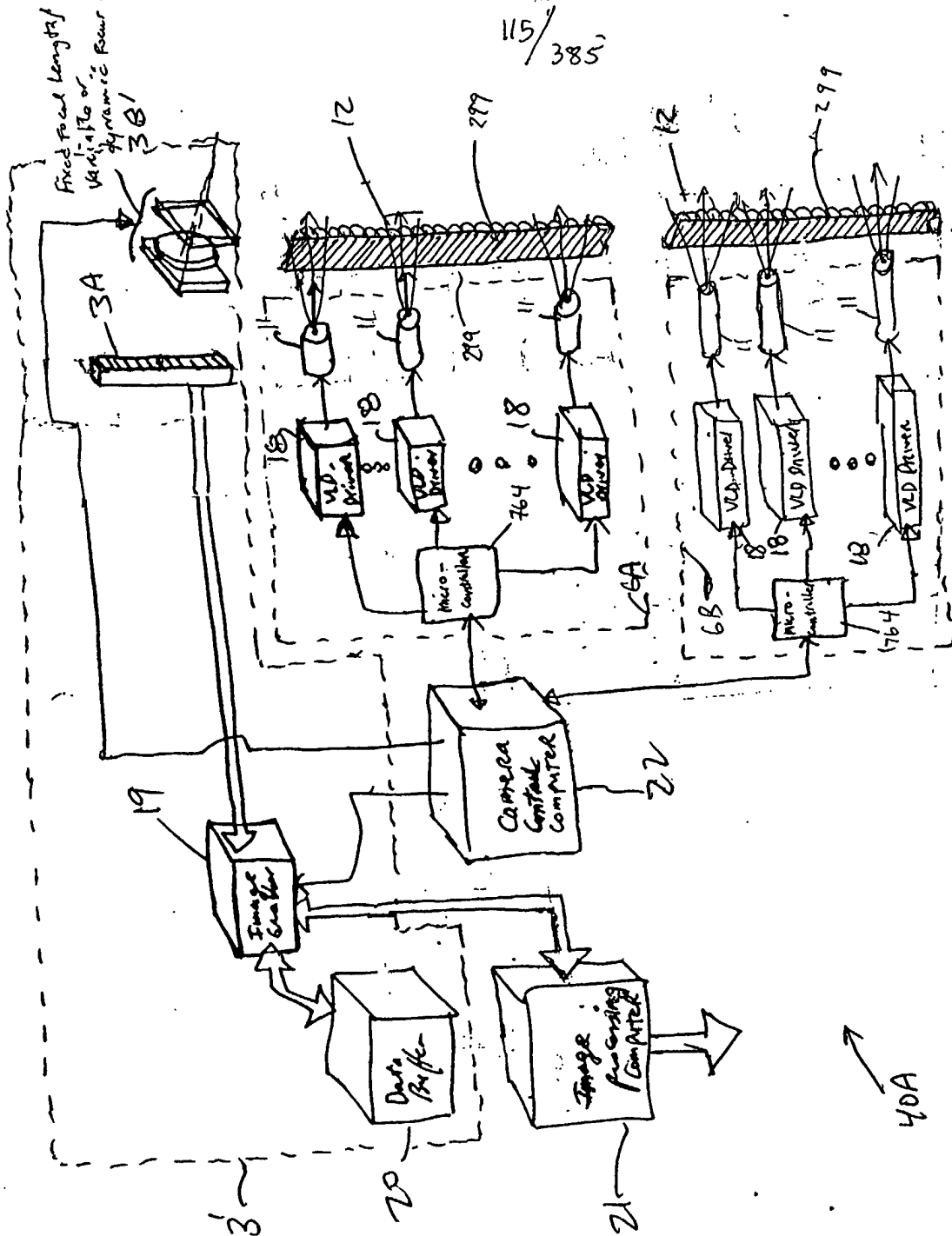


FIG. 2B2

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40A

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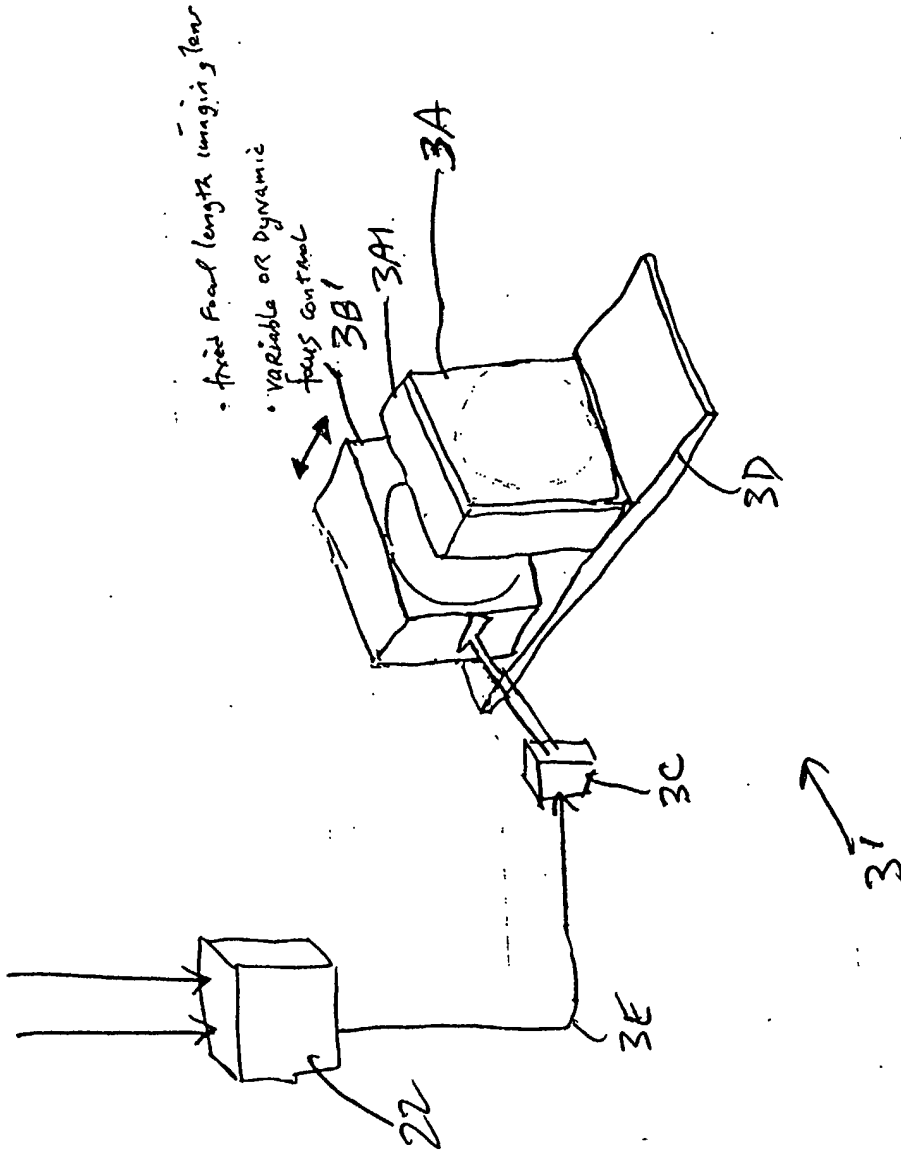
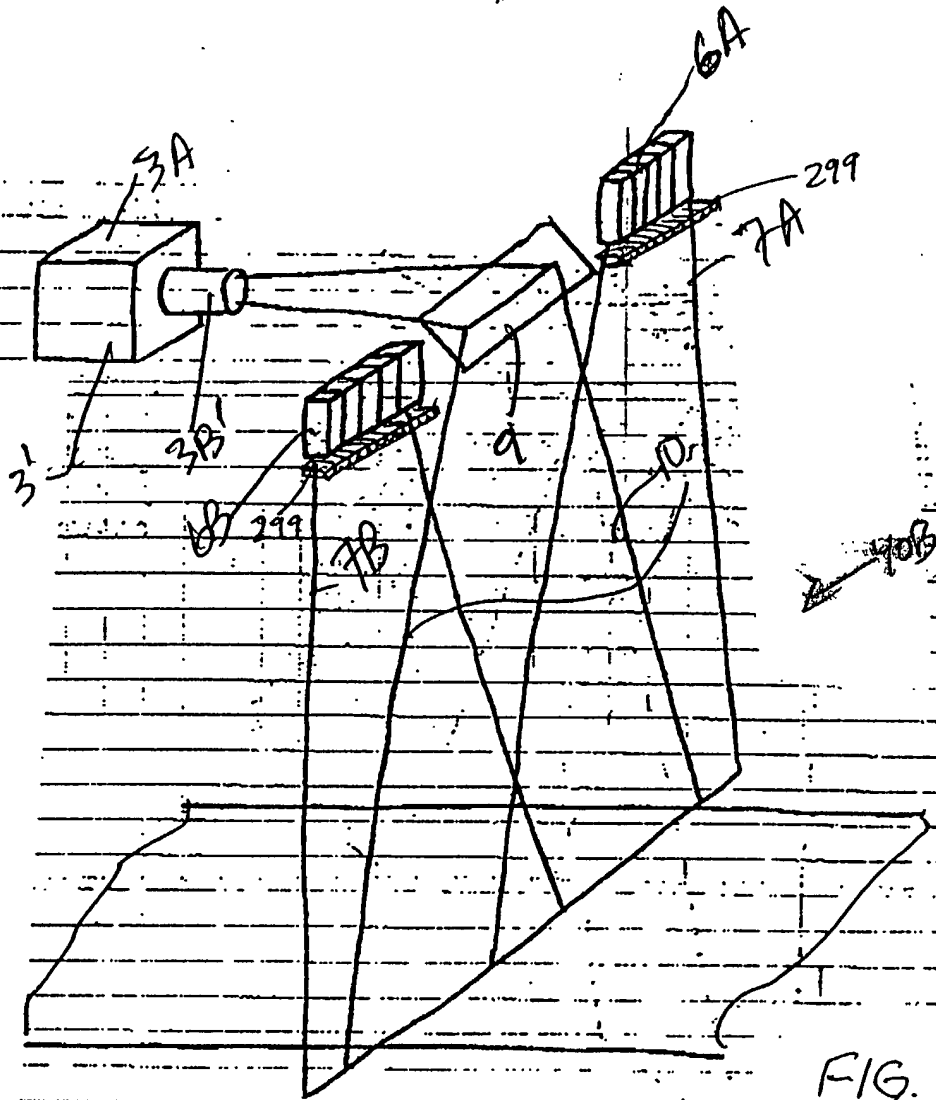


FIG. 2C2

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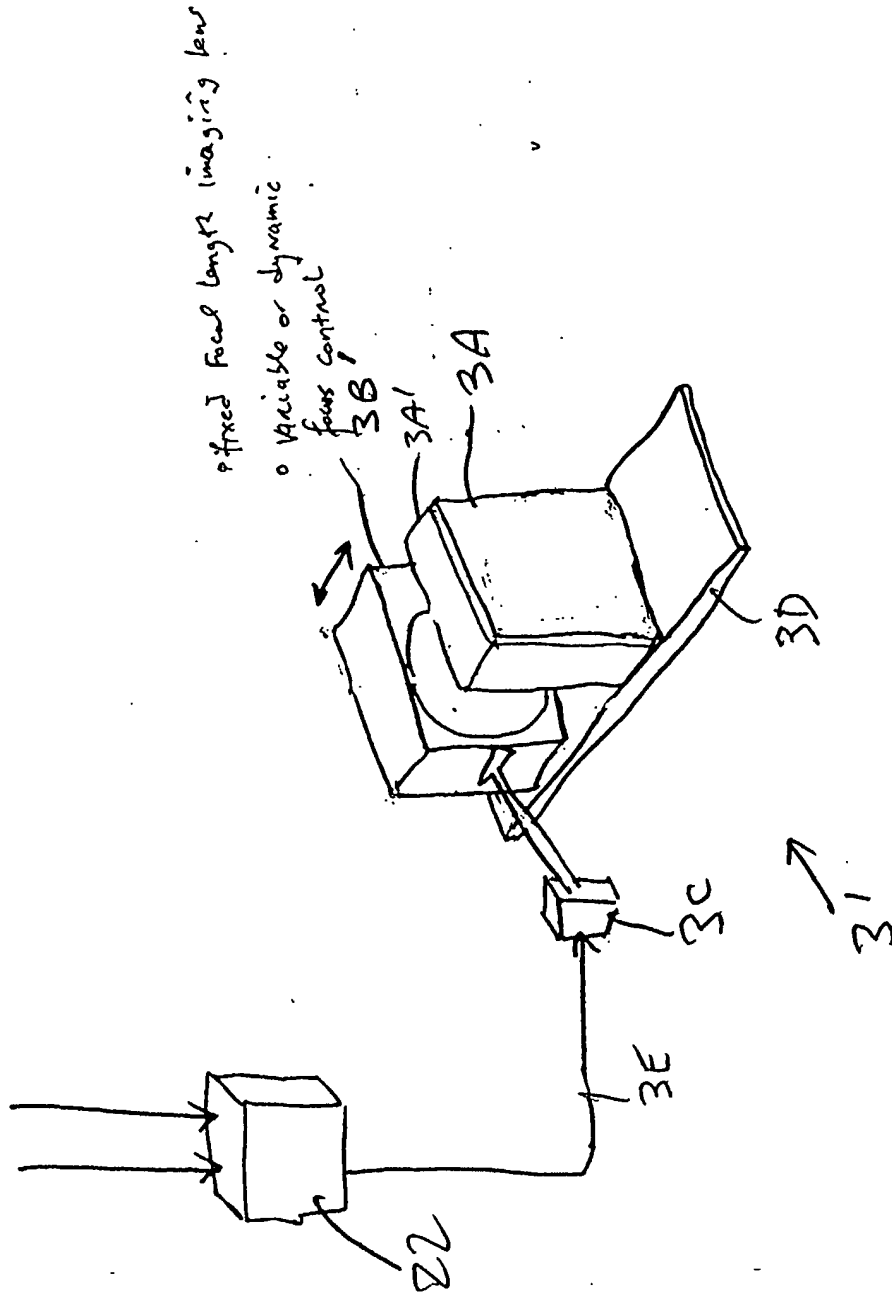


FIG. 2D3

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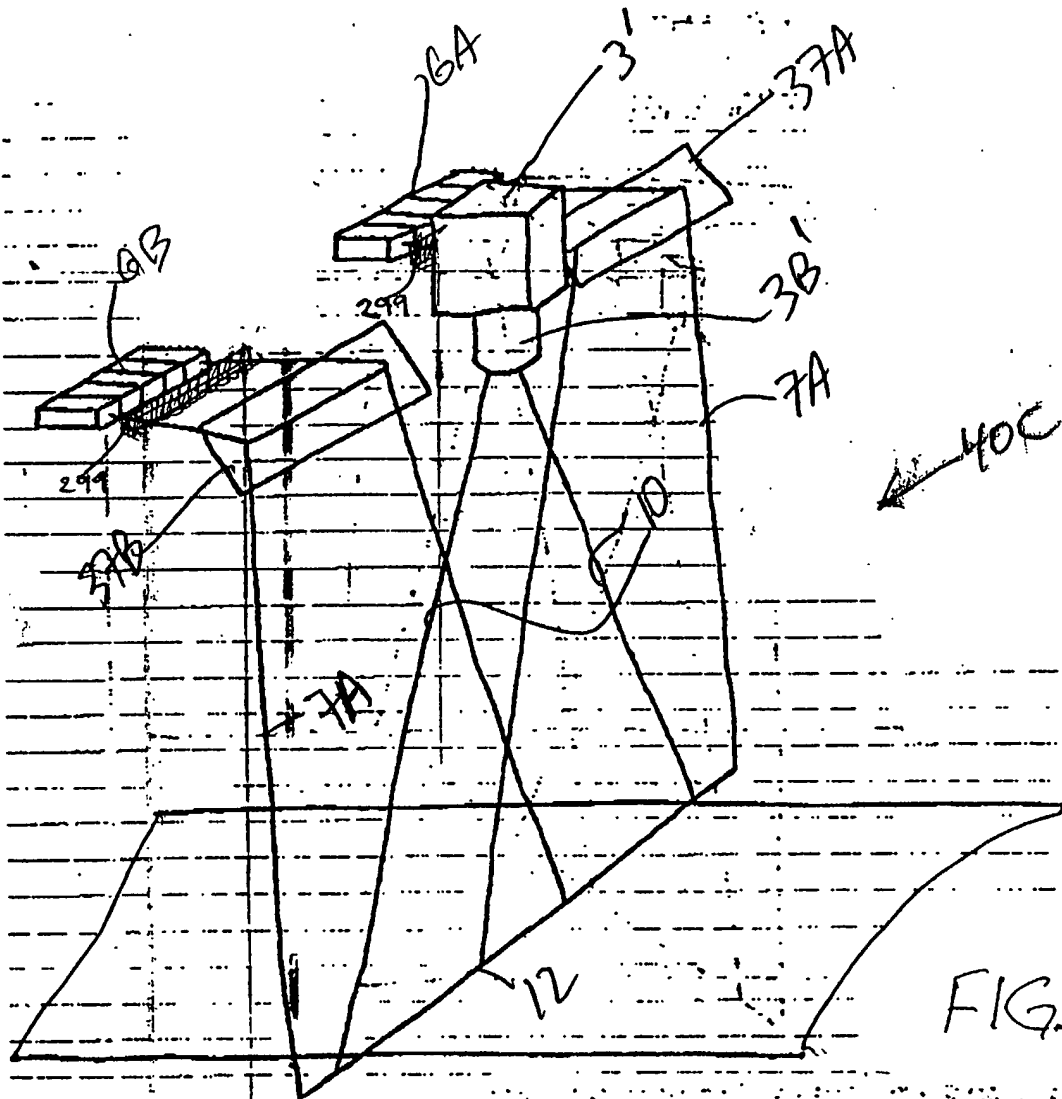


FIG. 2E1

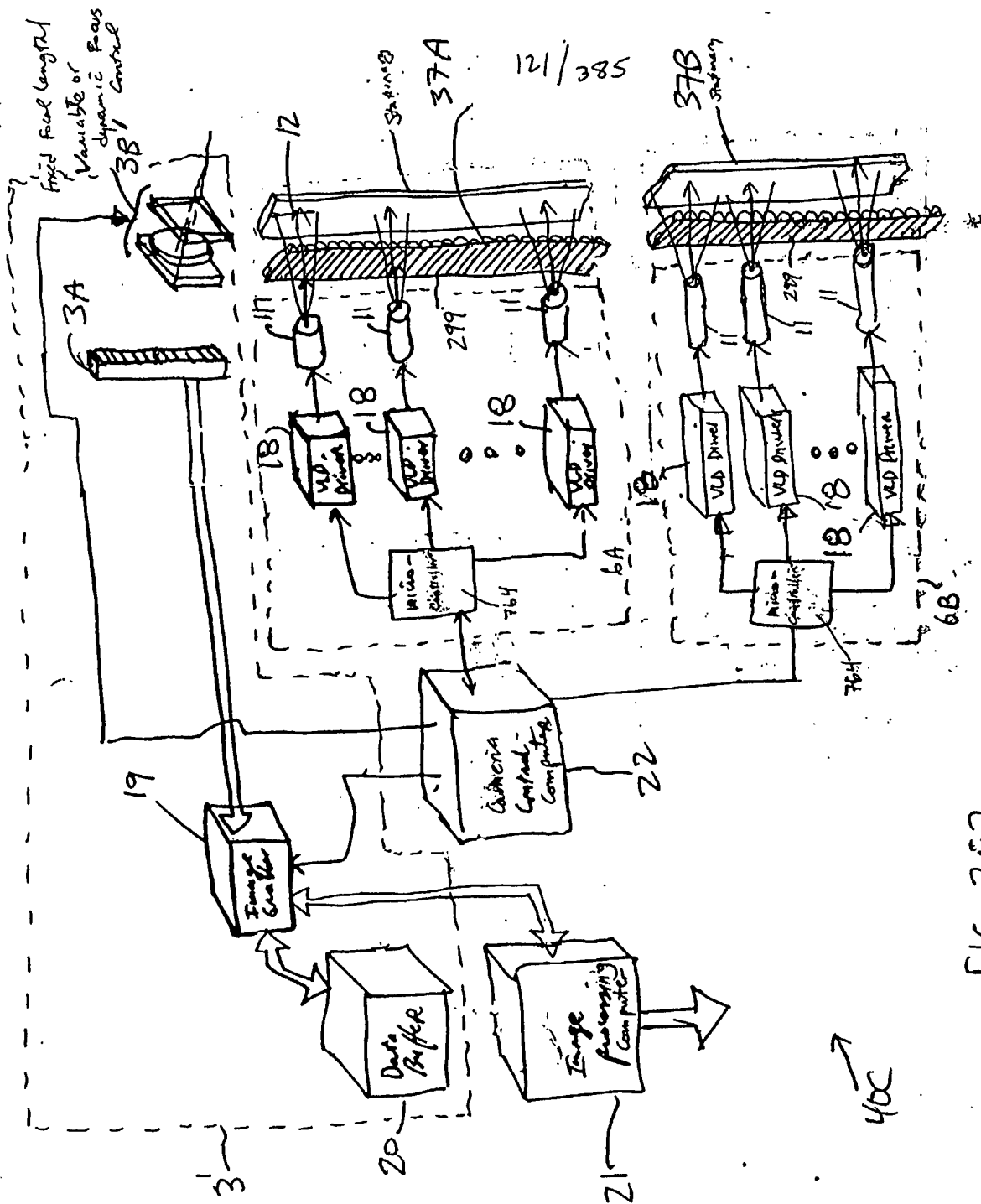


FIG. 2E2

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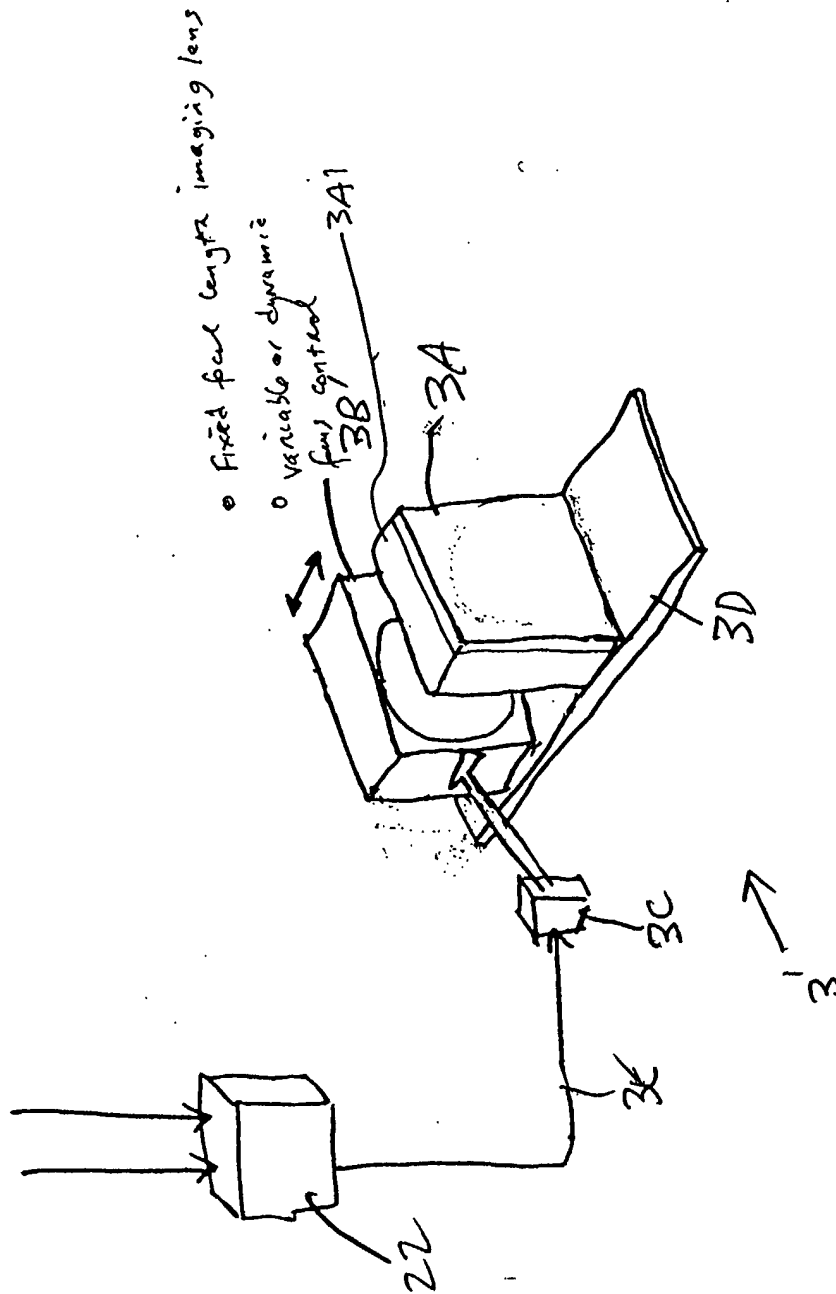
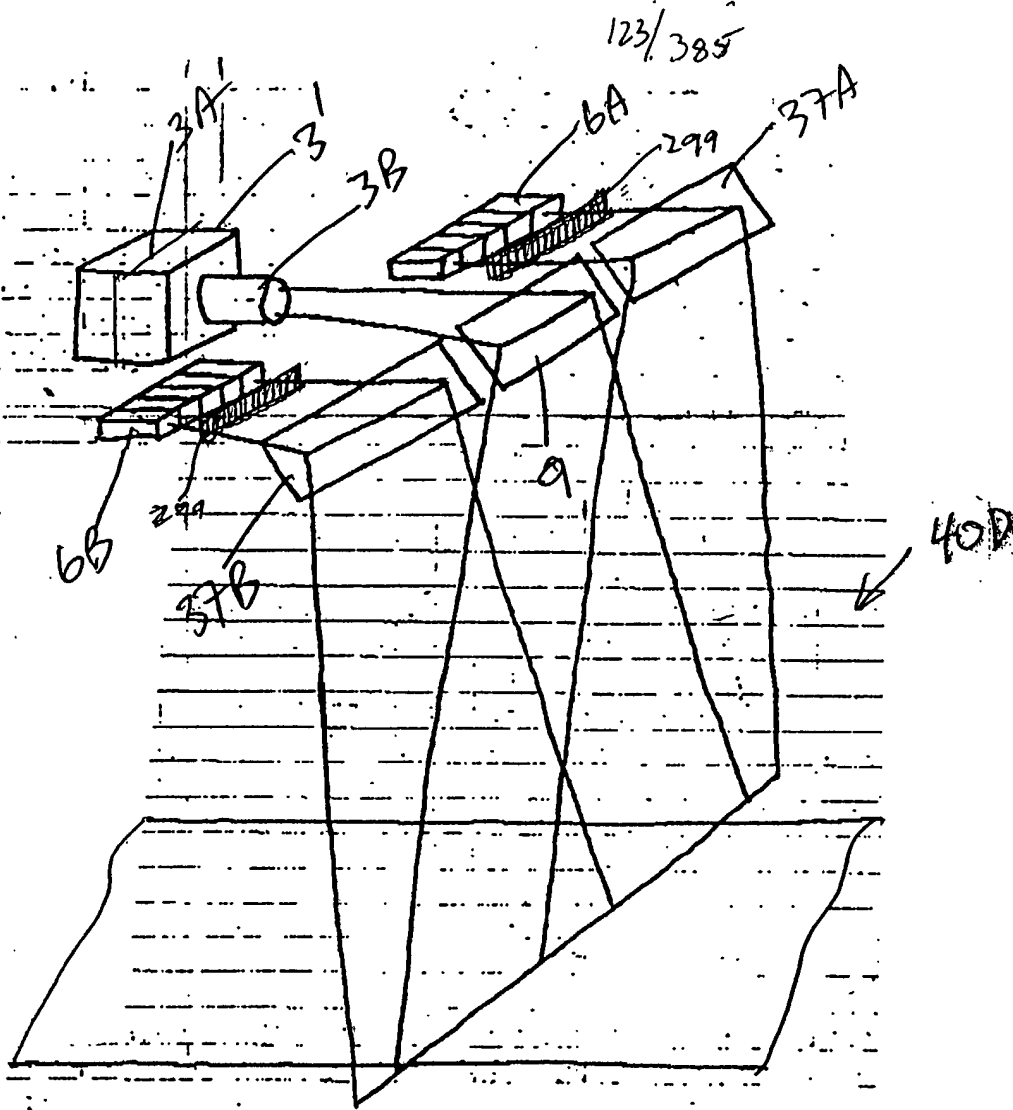


FIG. 2E3



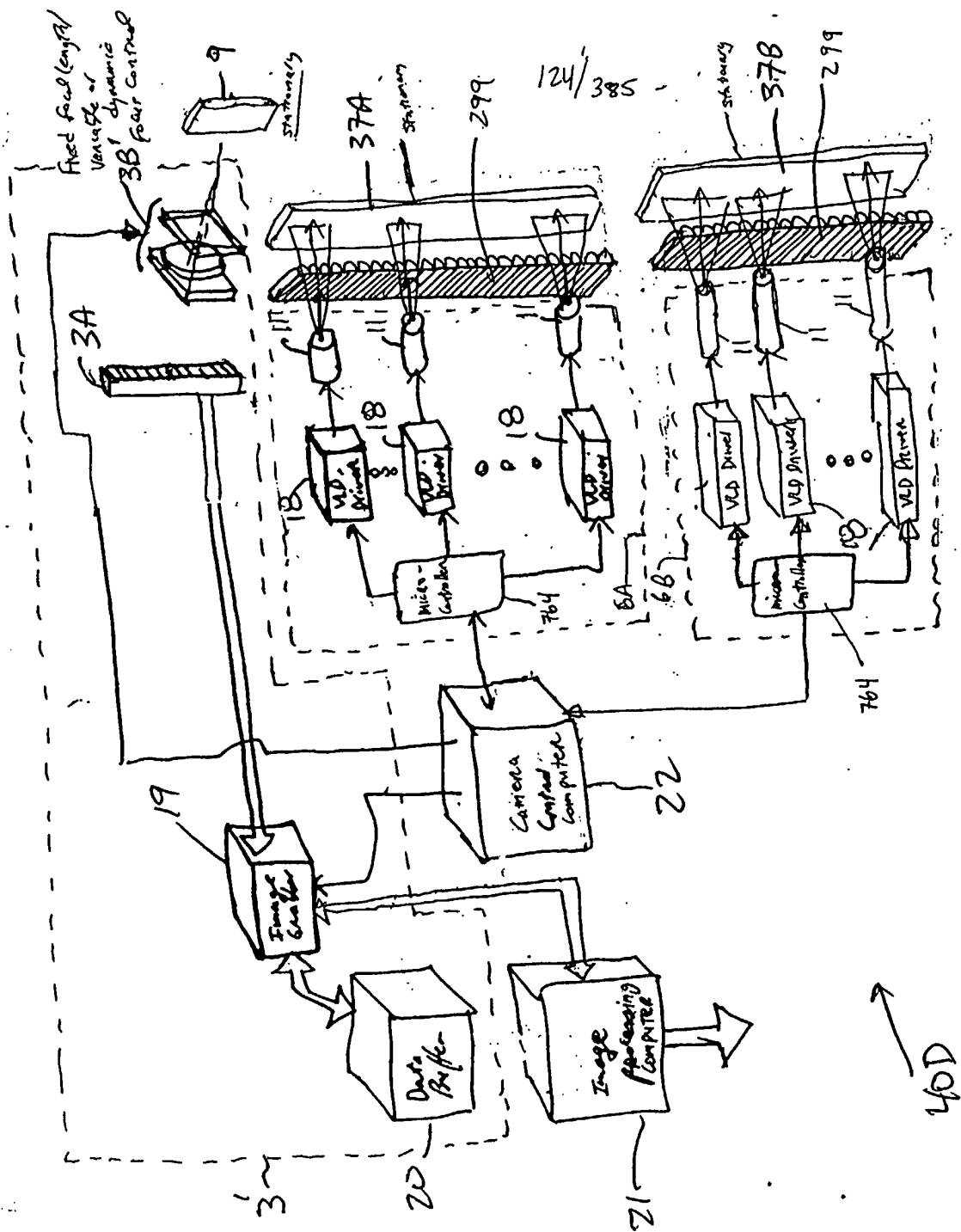


FIG. 2FZ

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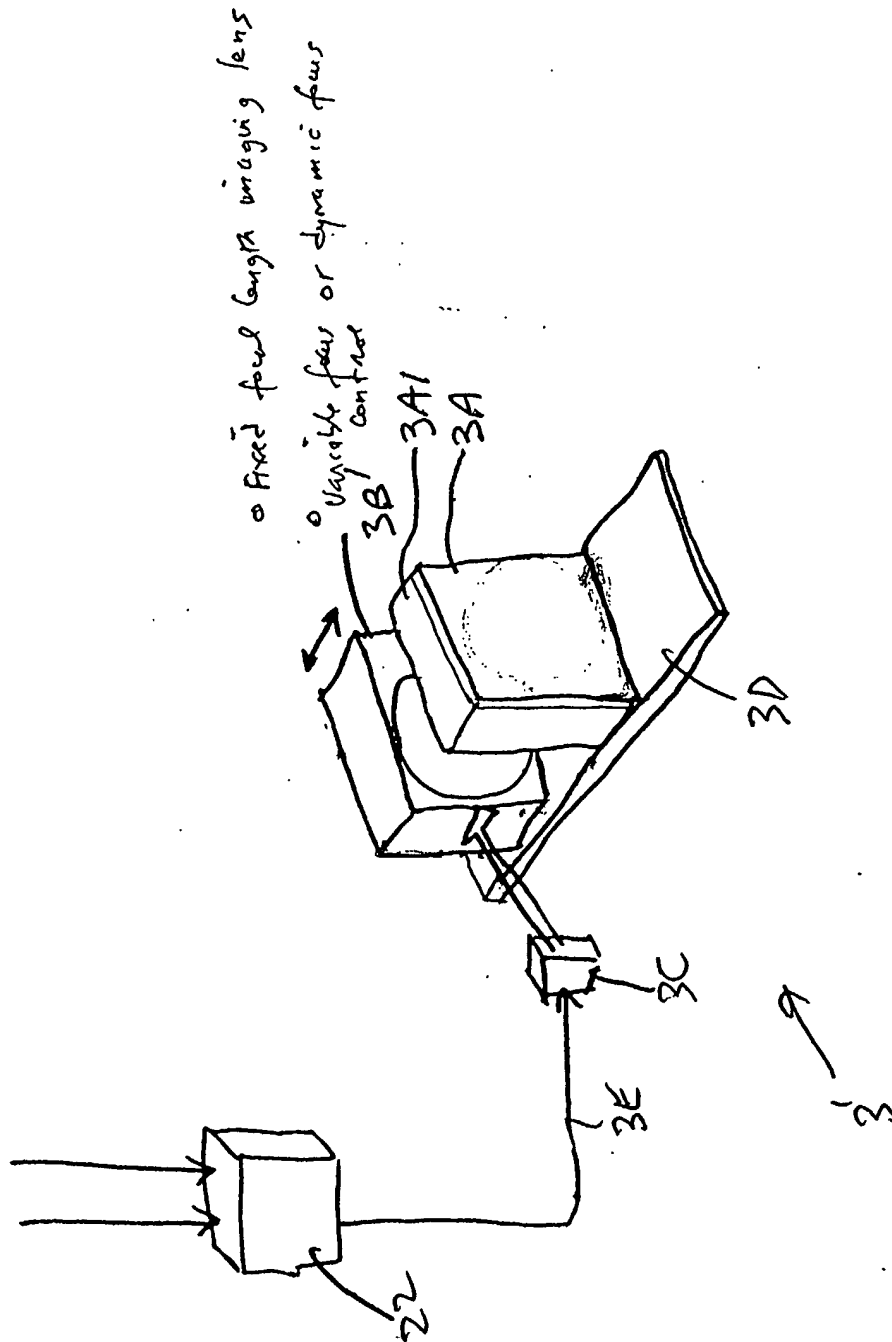


FIG. 2F3

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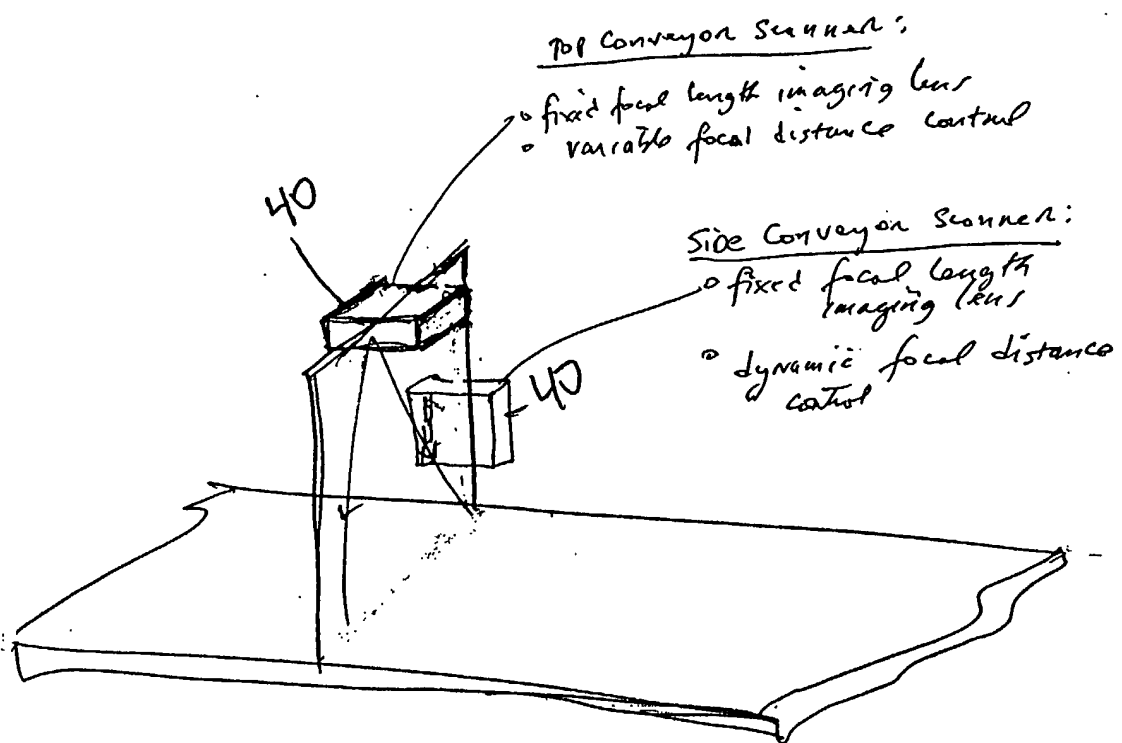
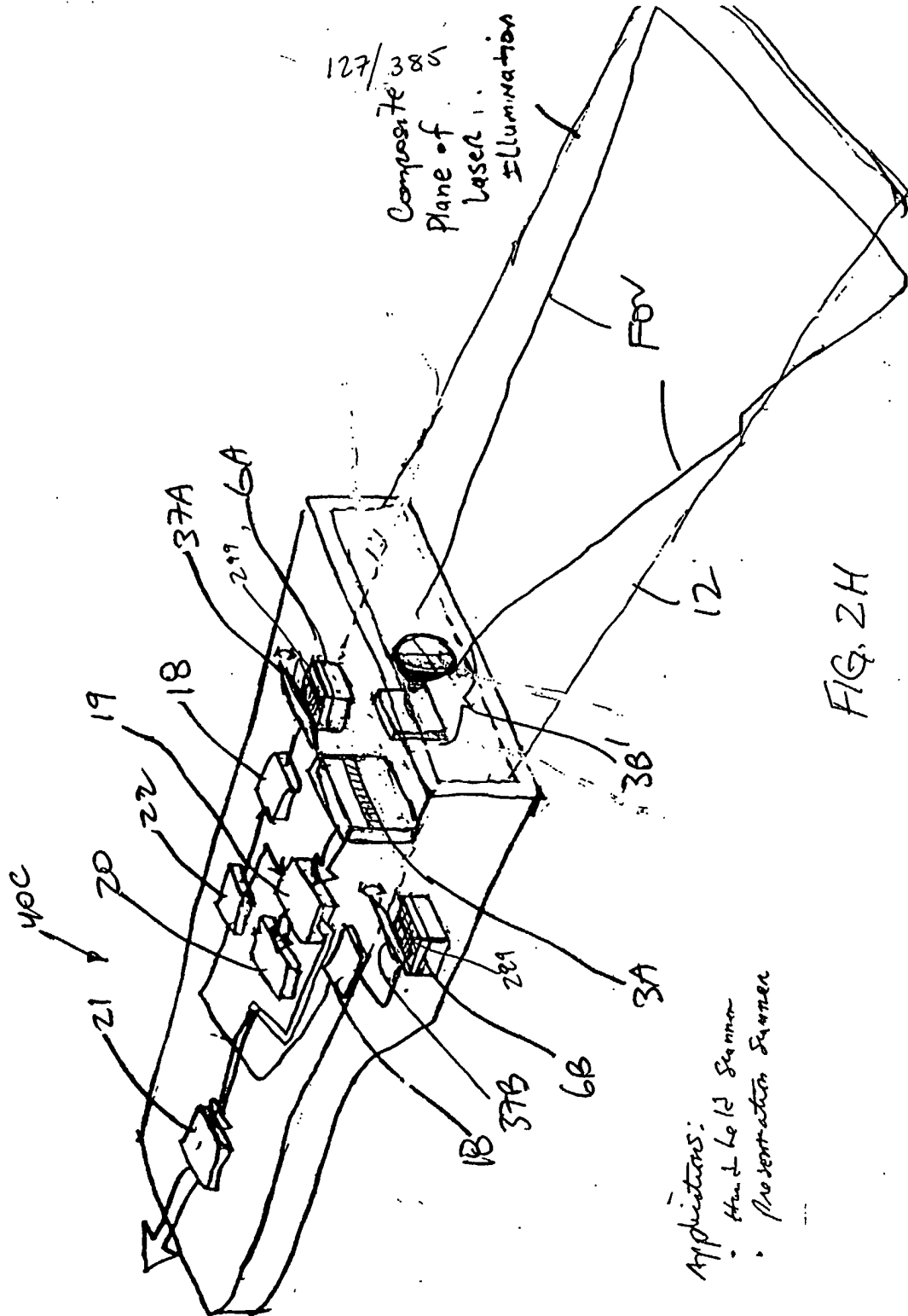


FIG. 2G



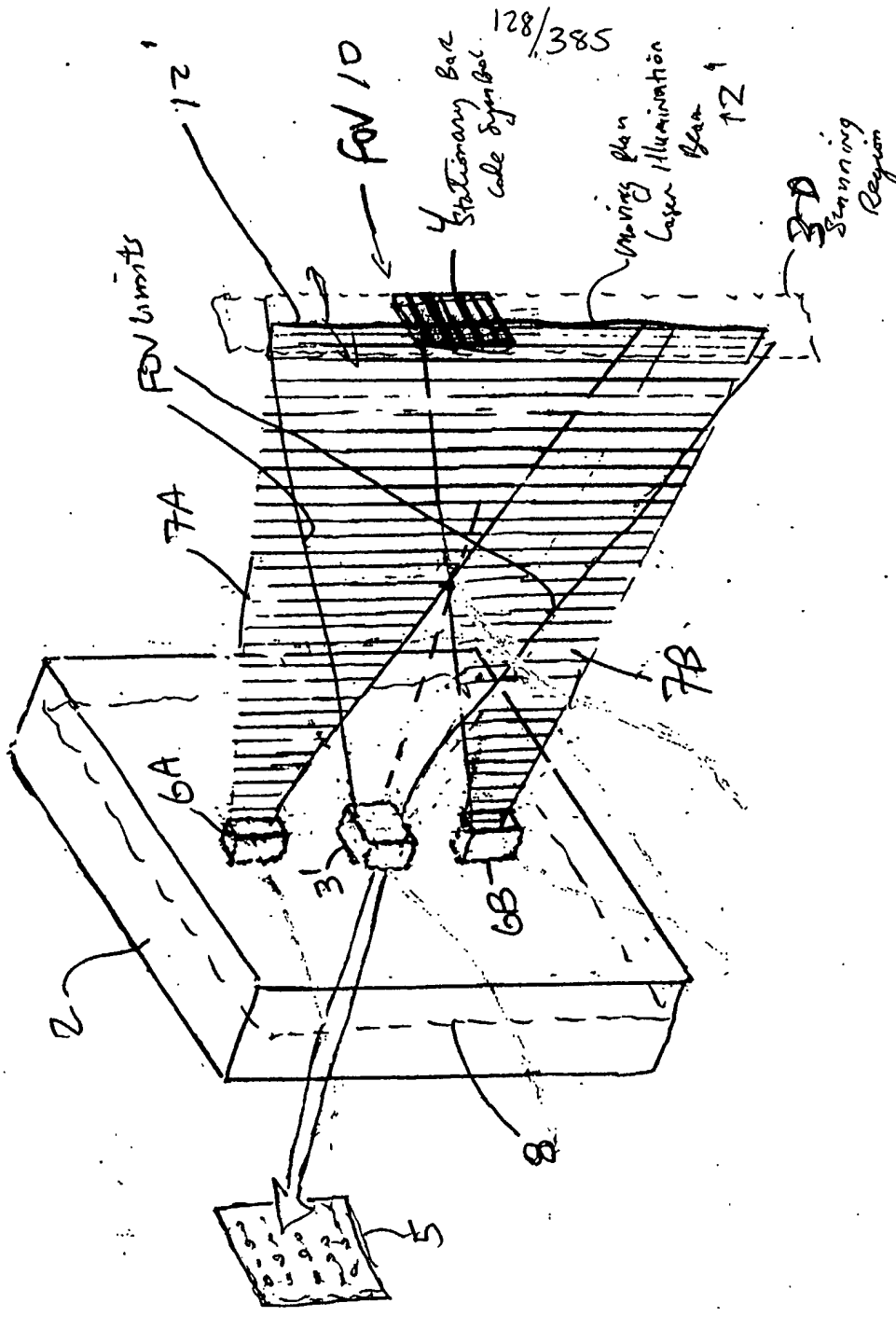
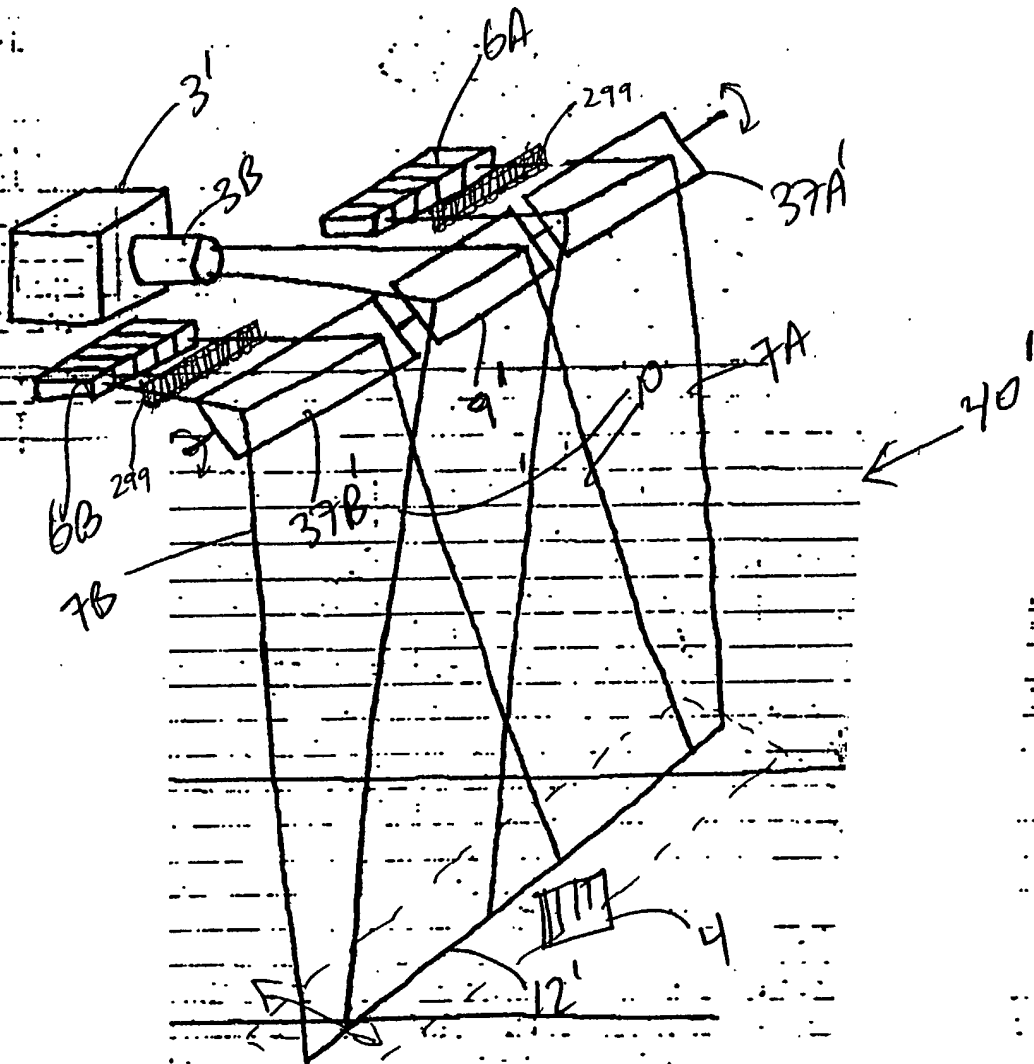


FIG. 2II

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3-D
Scanning
Region

FIG 2I2

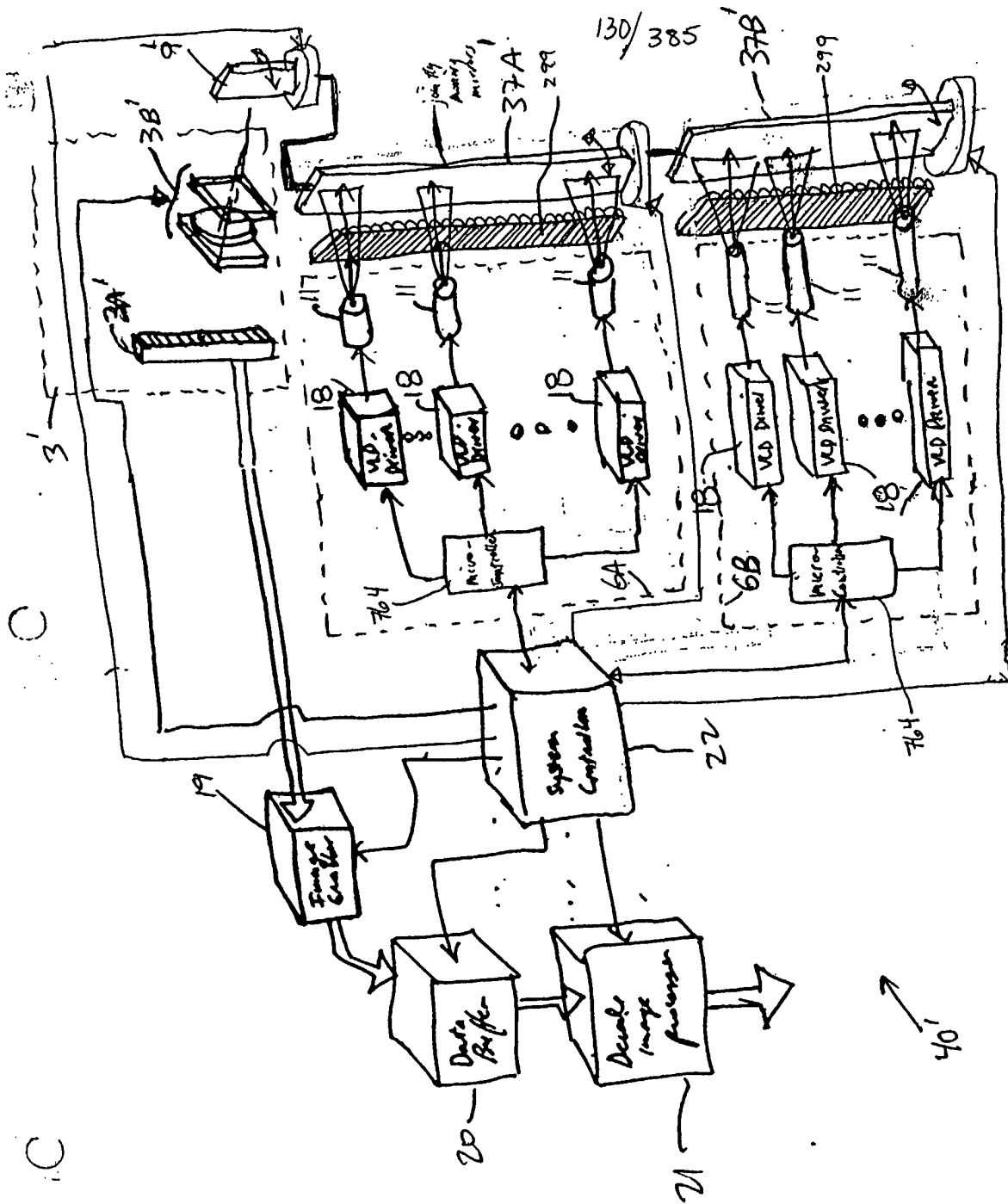


FIG. 2I3

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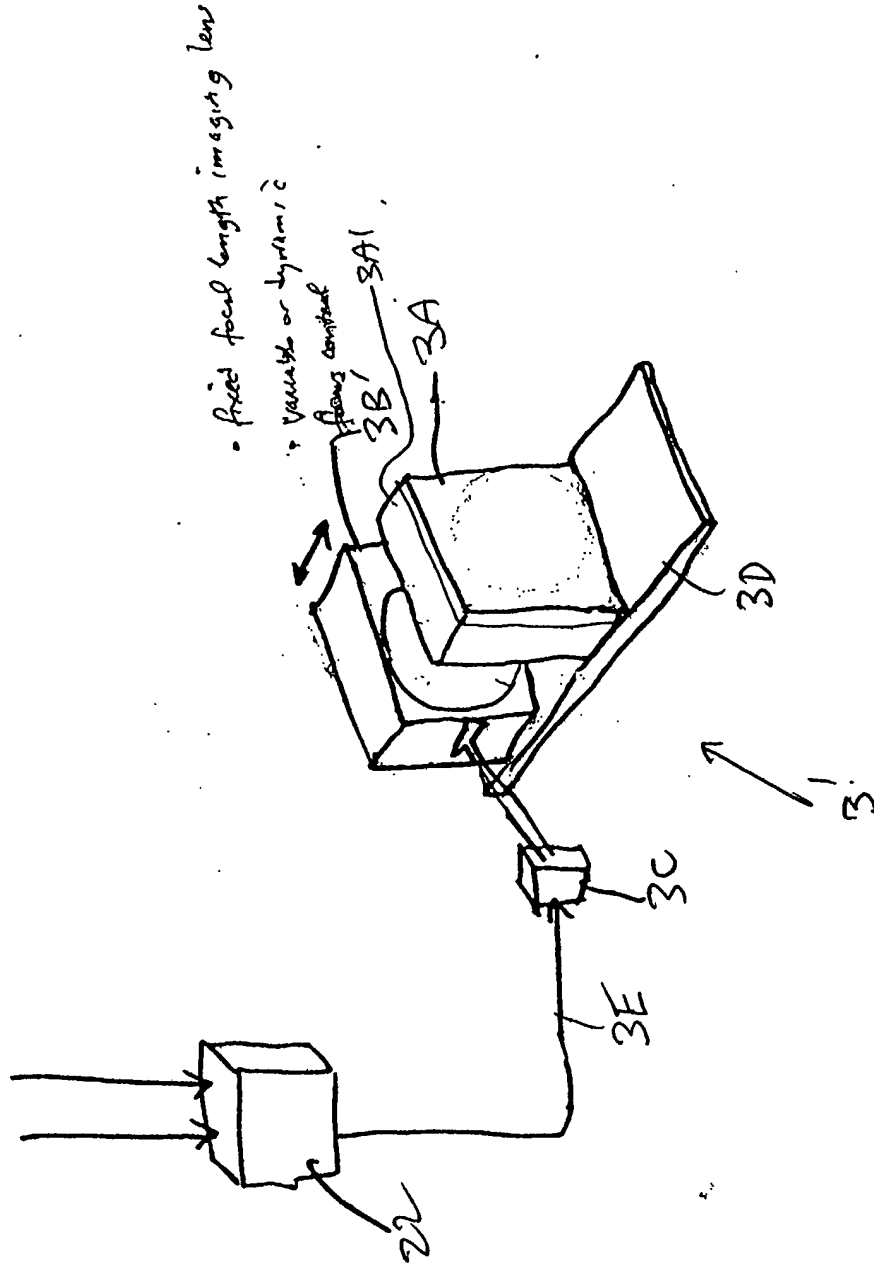


FIG. 2I4

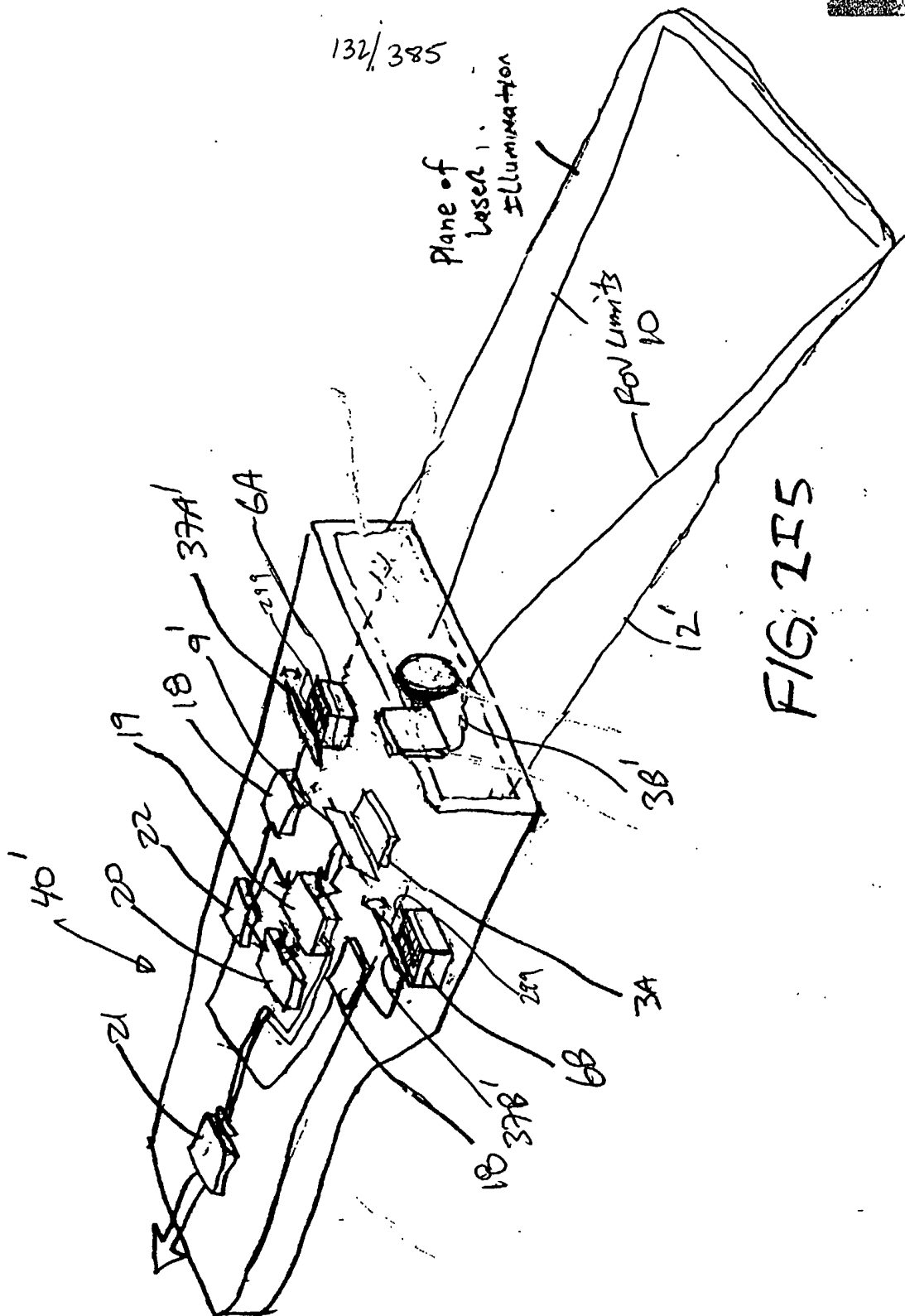


FIG. 215

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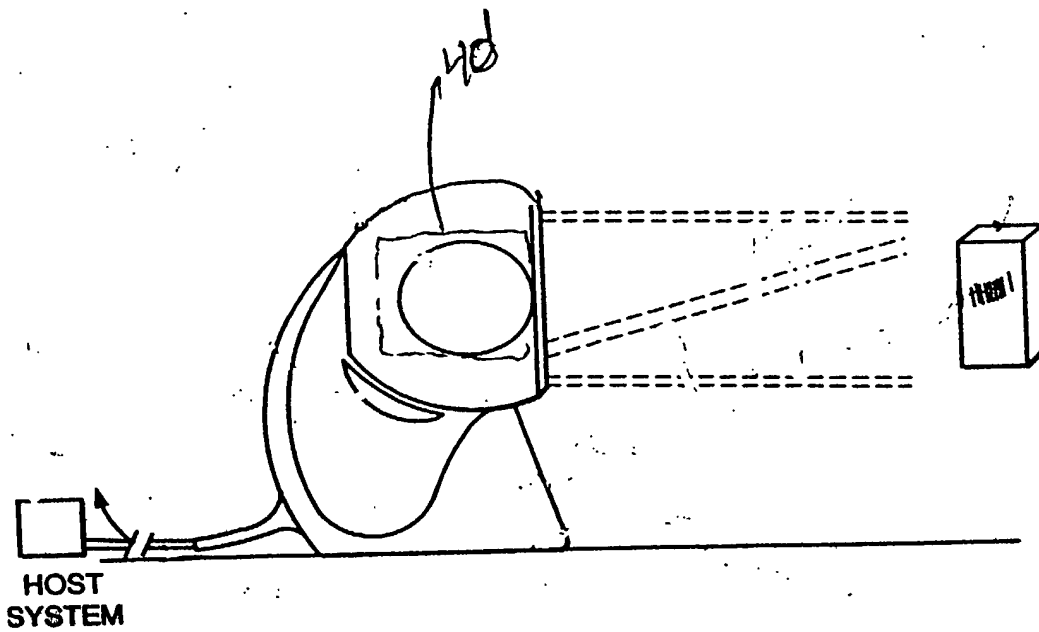


FIG. 2I6

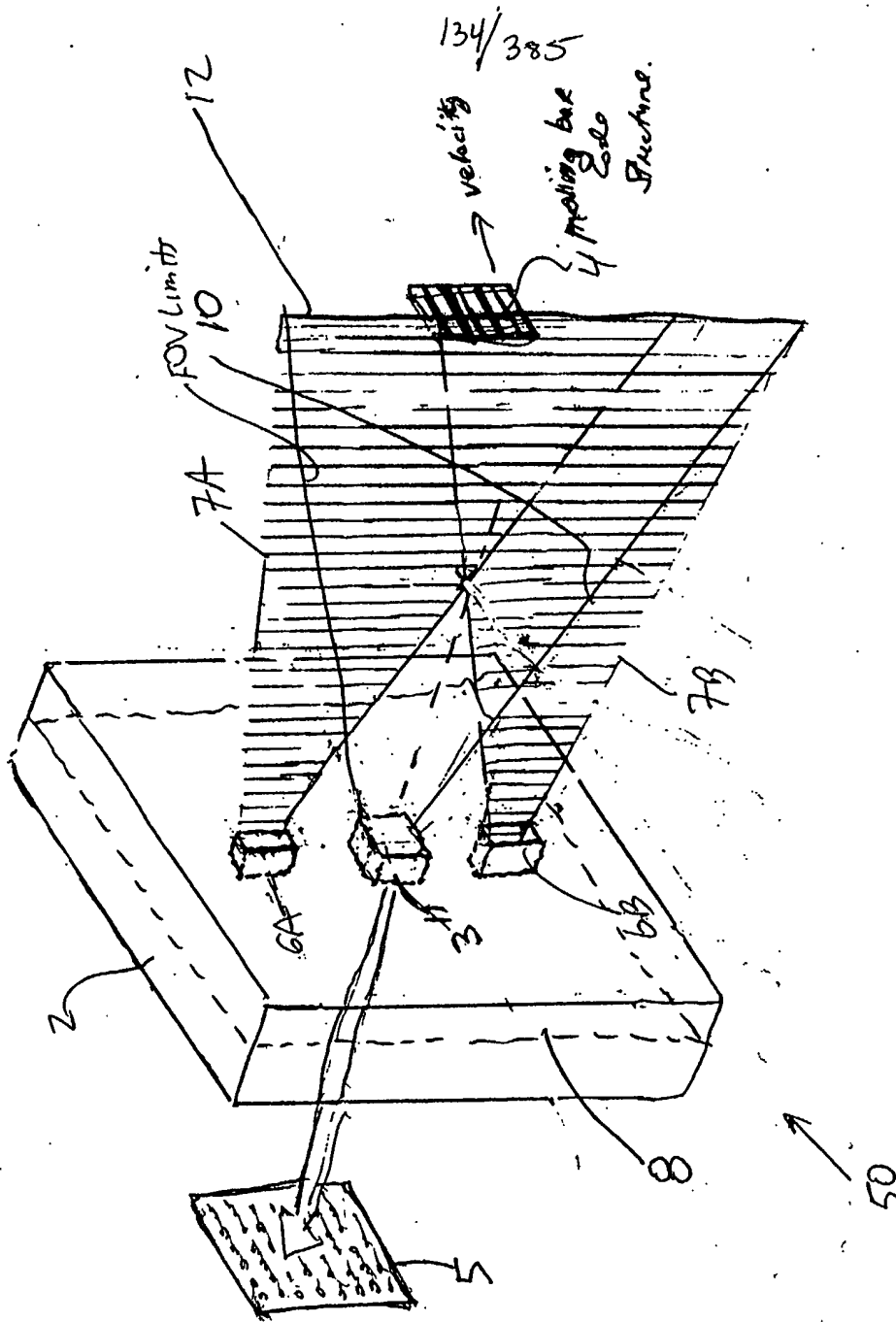


FIG 3A

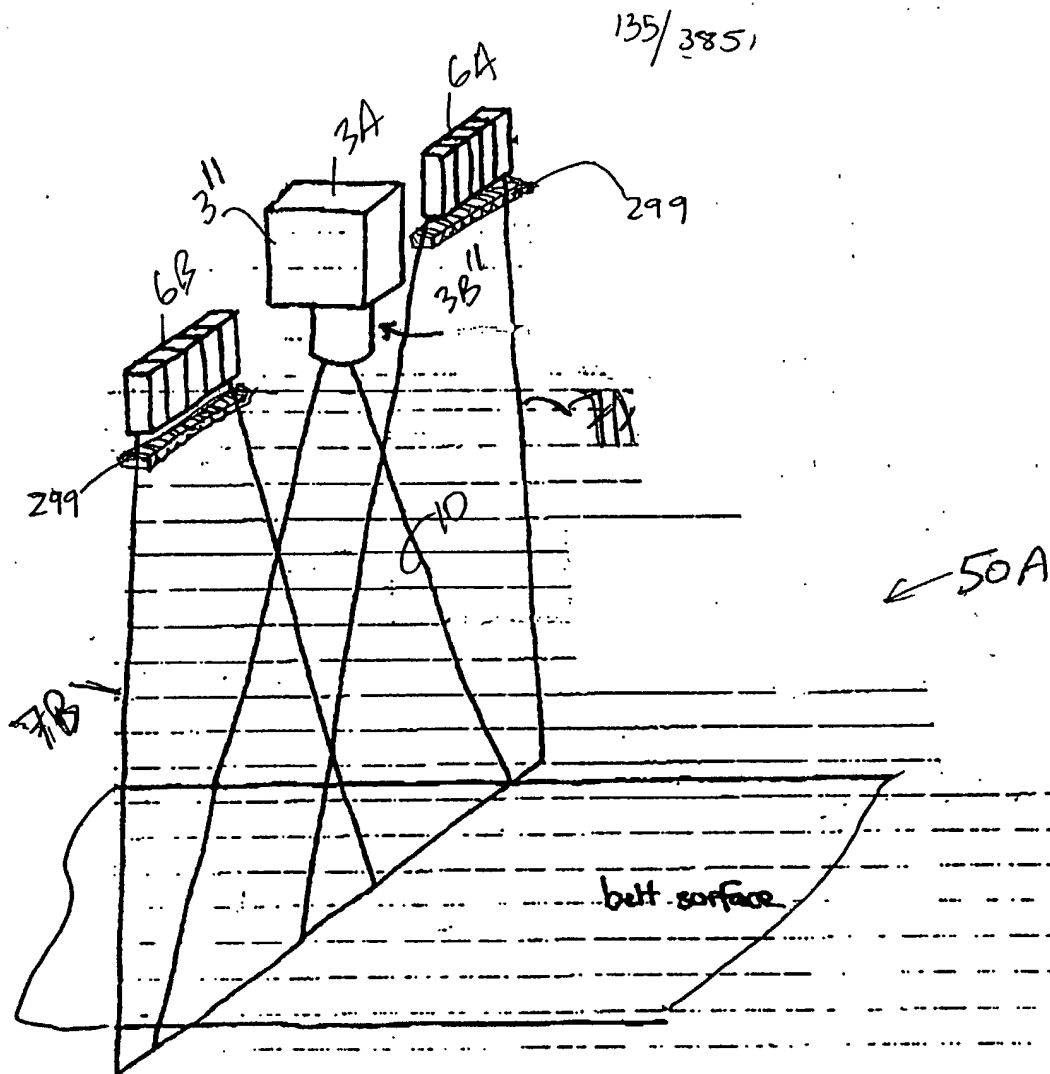


FIG. 3B1

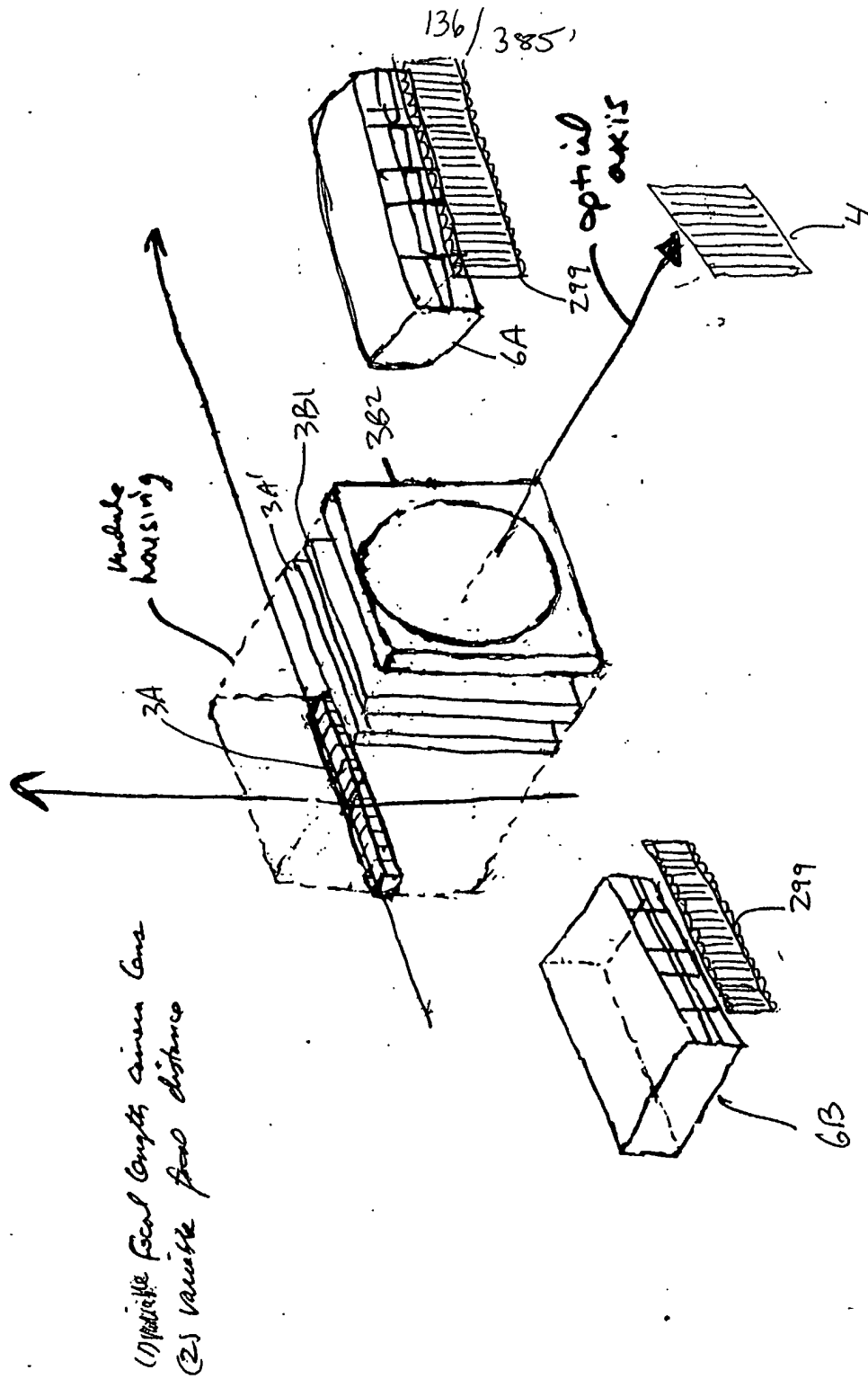


FIG. 3B2

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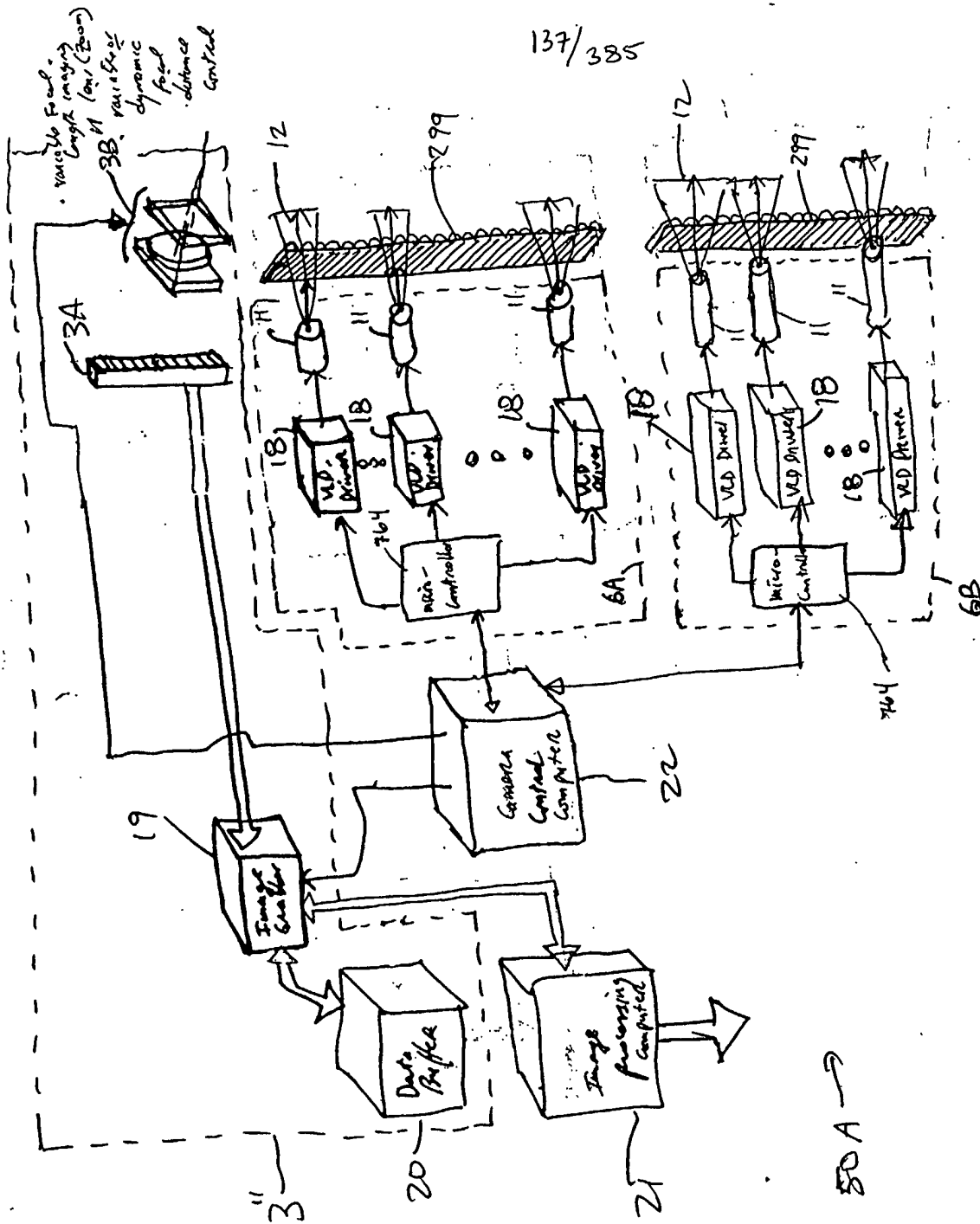


Fig 3C1

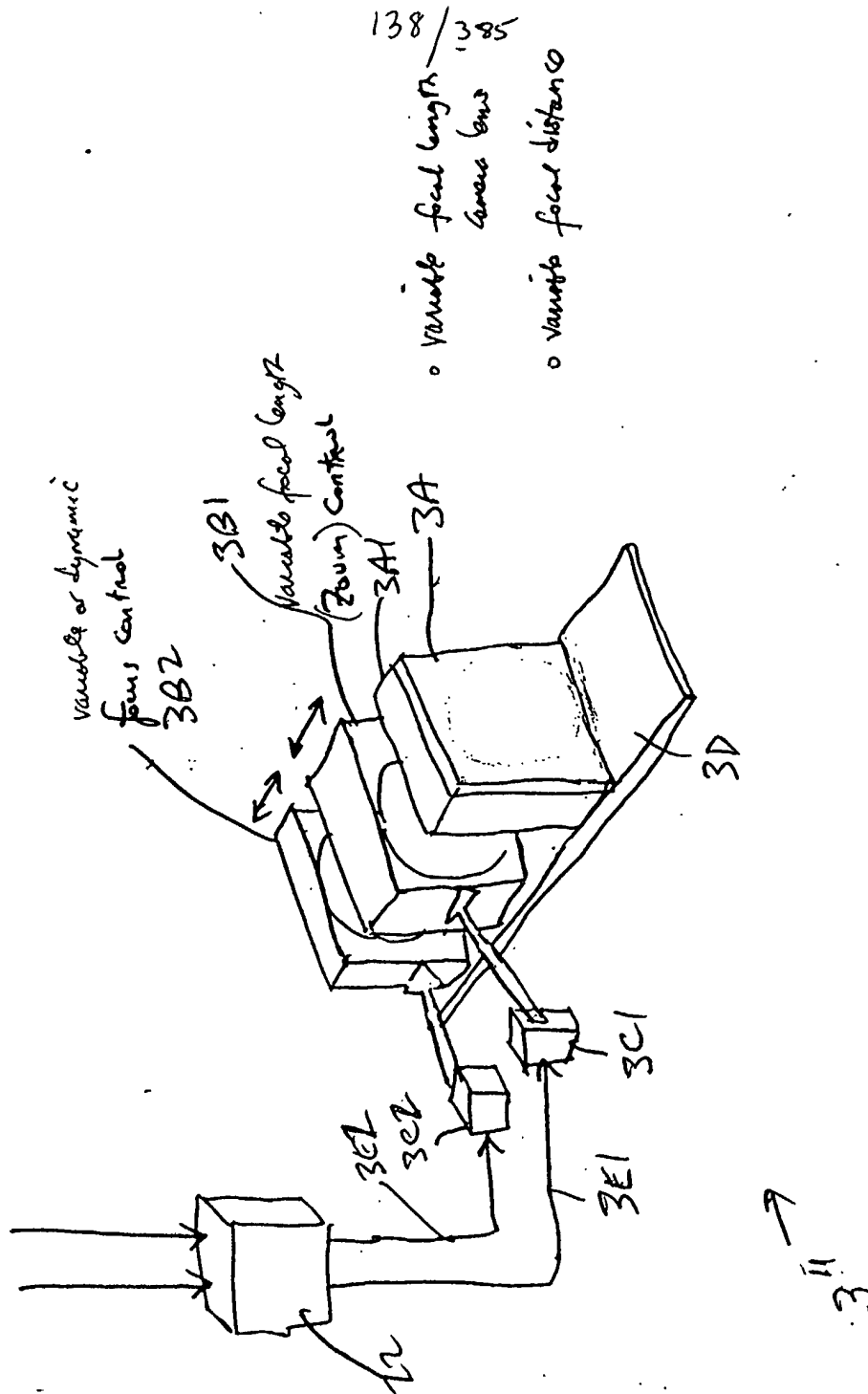
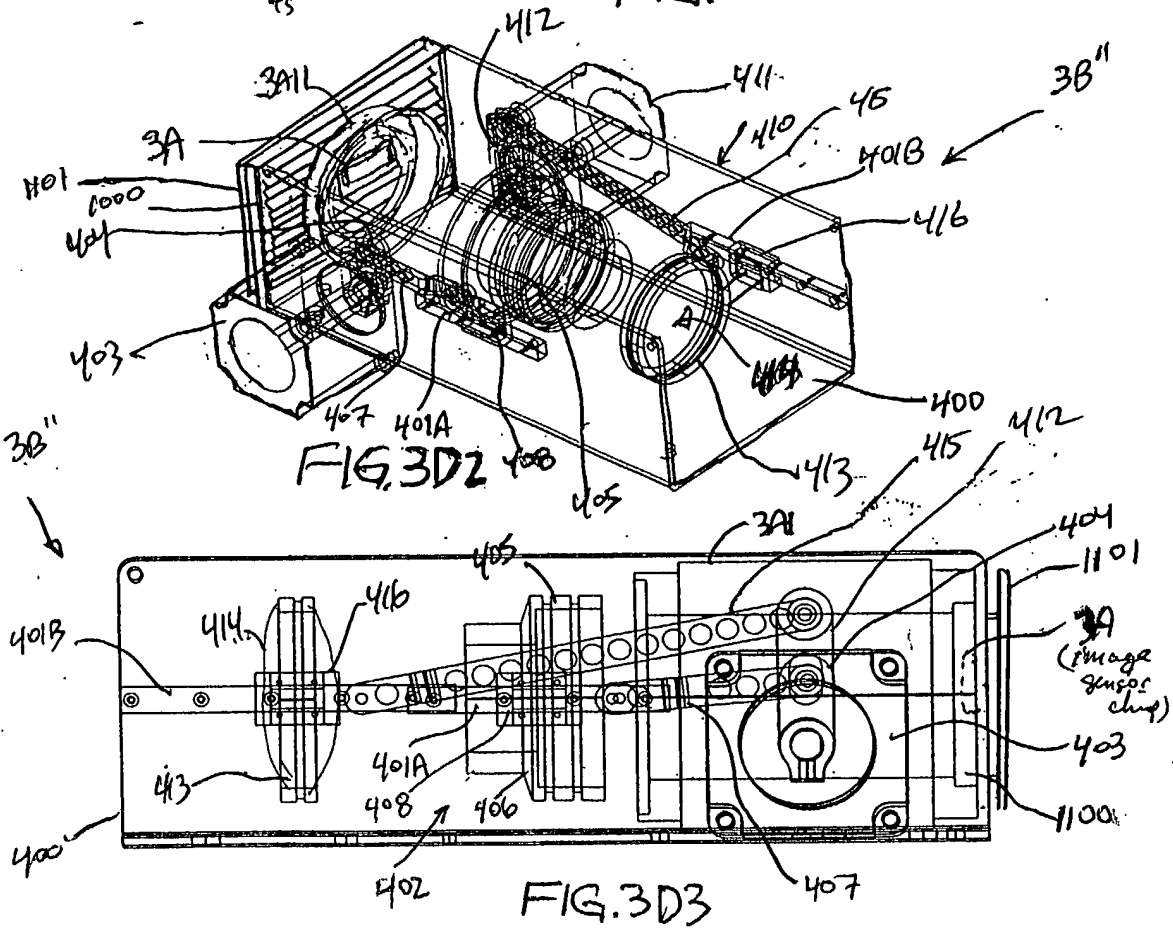
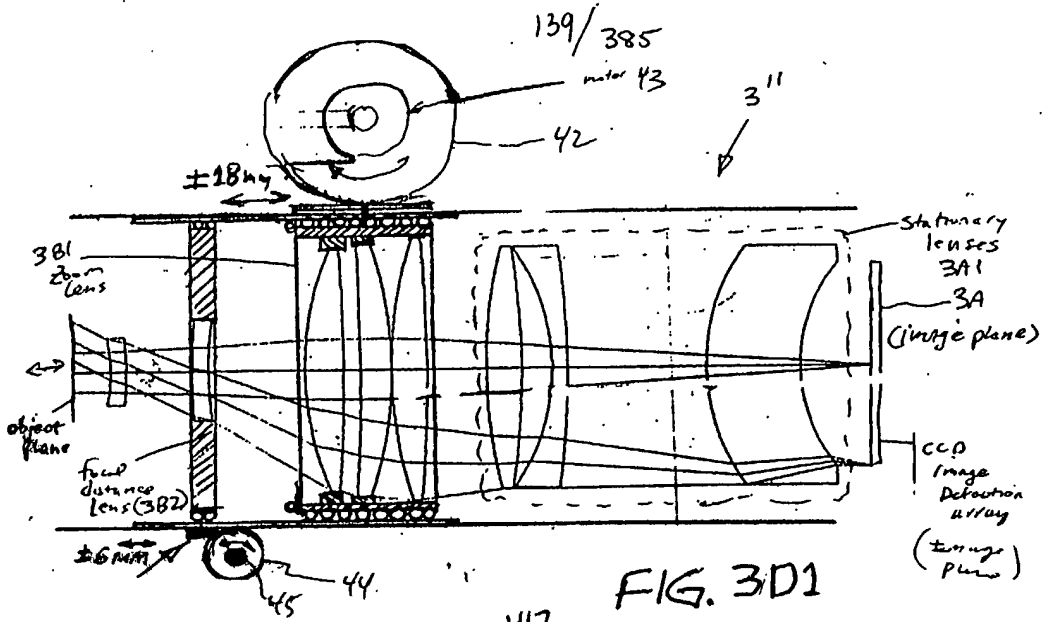


FIG. 3CZ



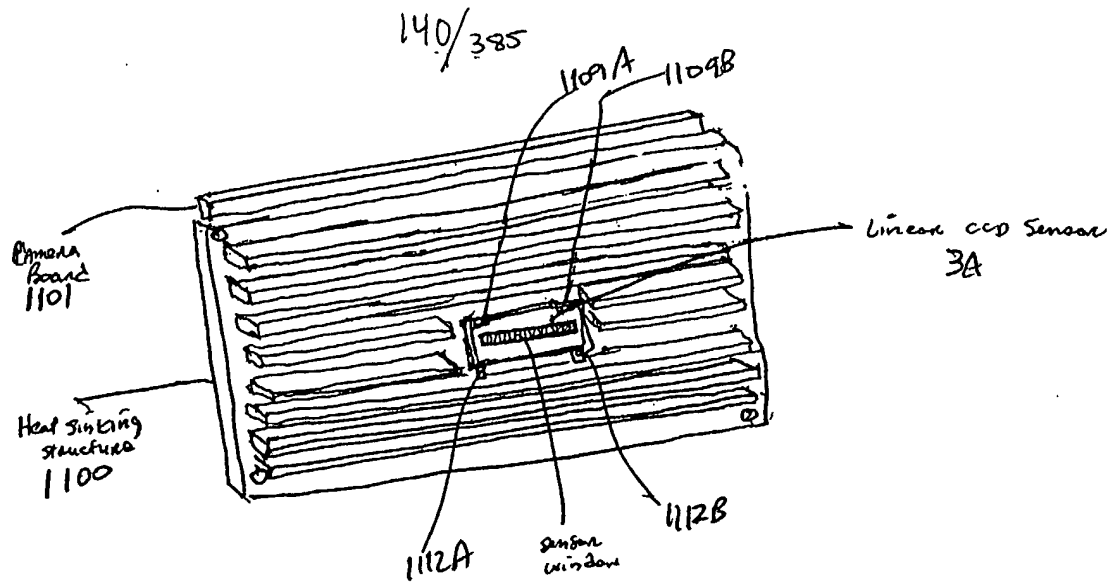


FIG. 3D4

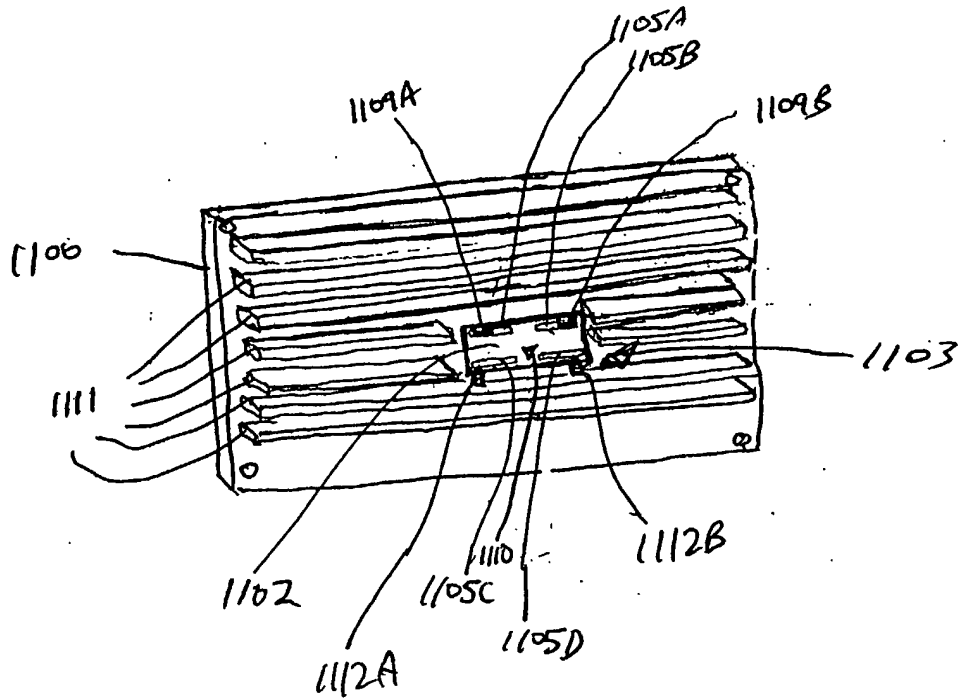


FIG. 3D5

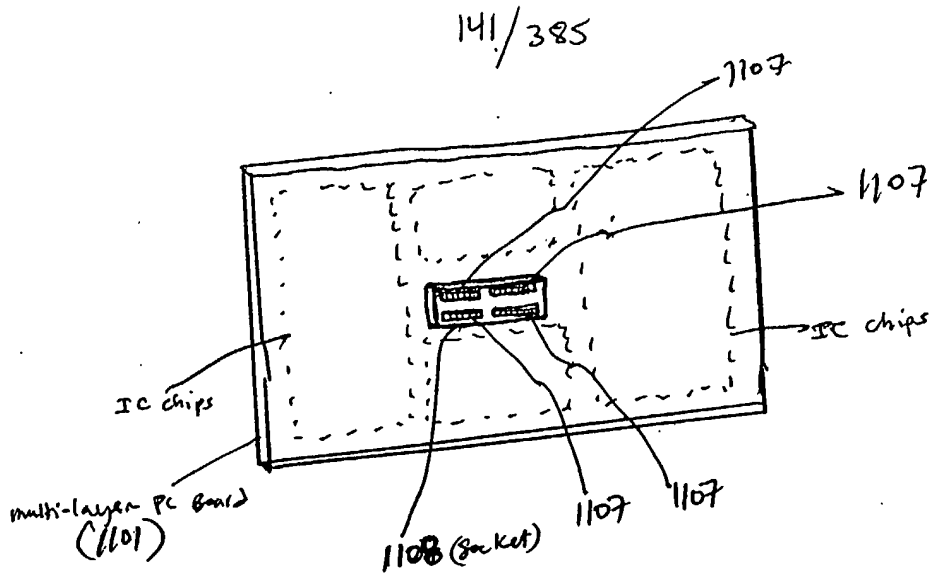


FIG. 3D6

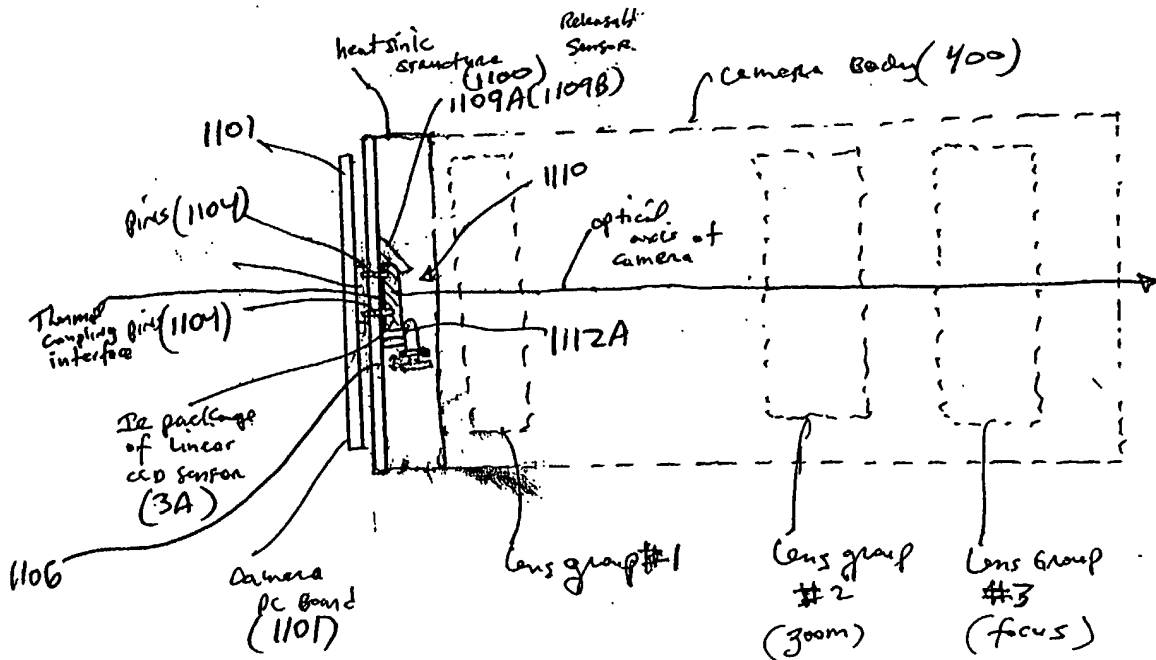


FIG. 3D7

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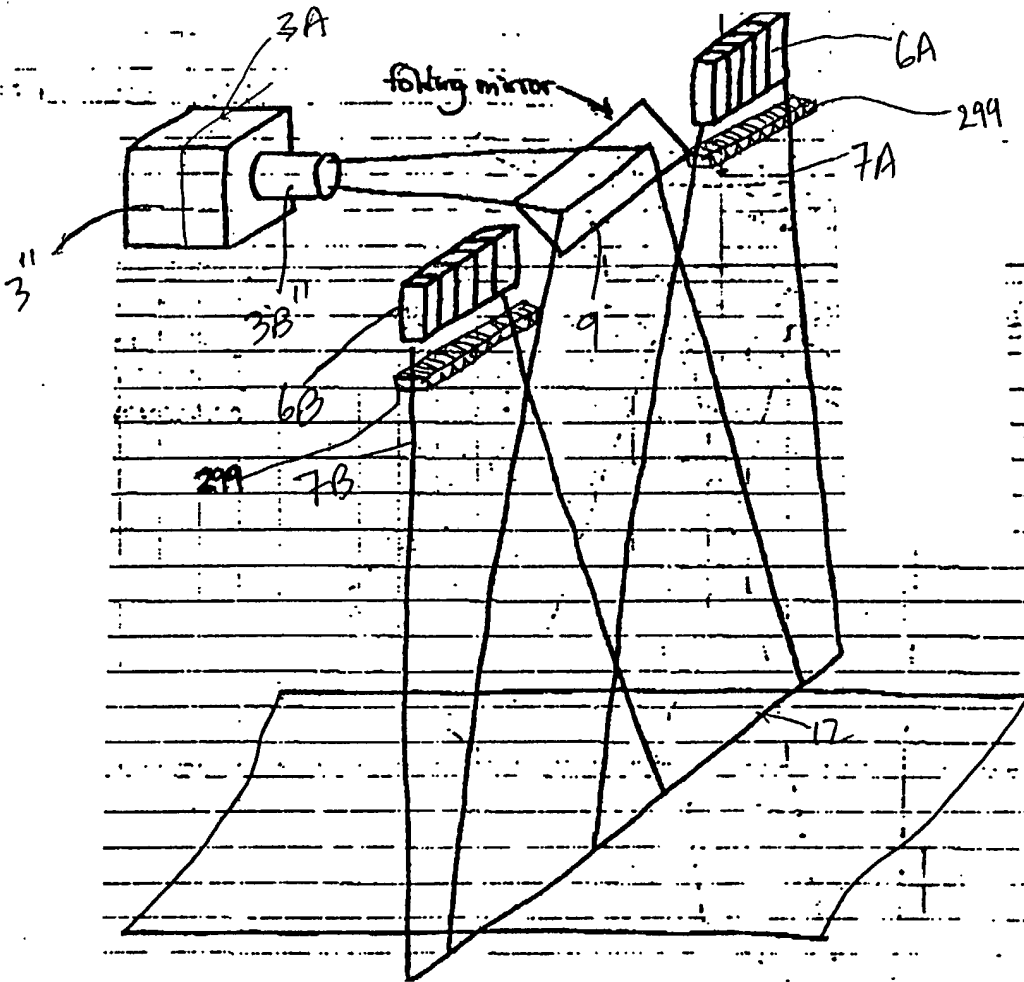
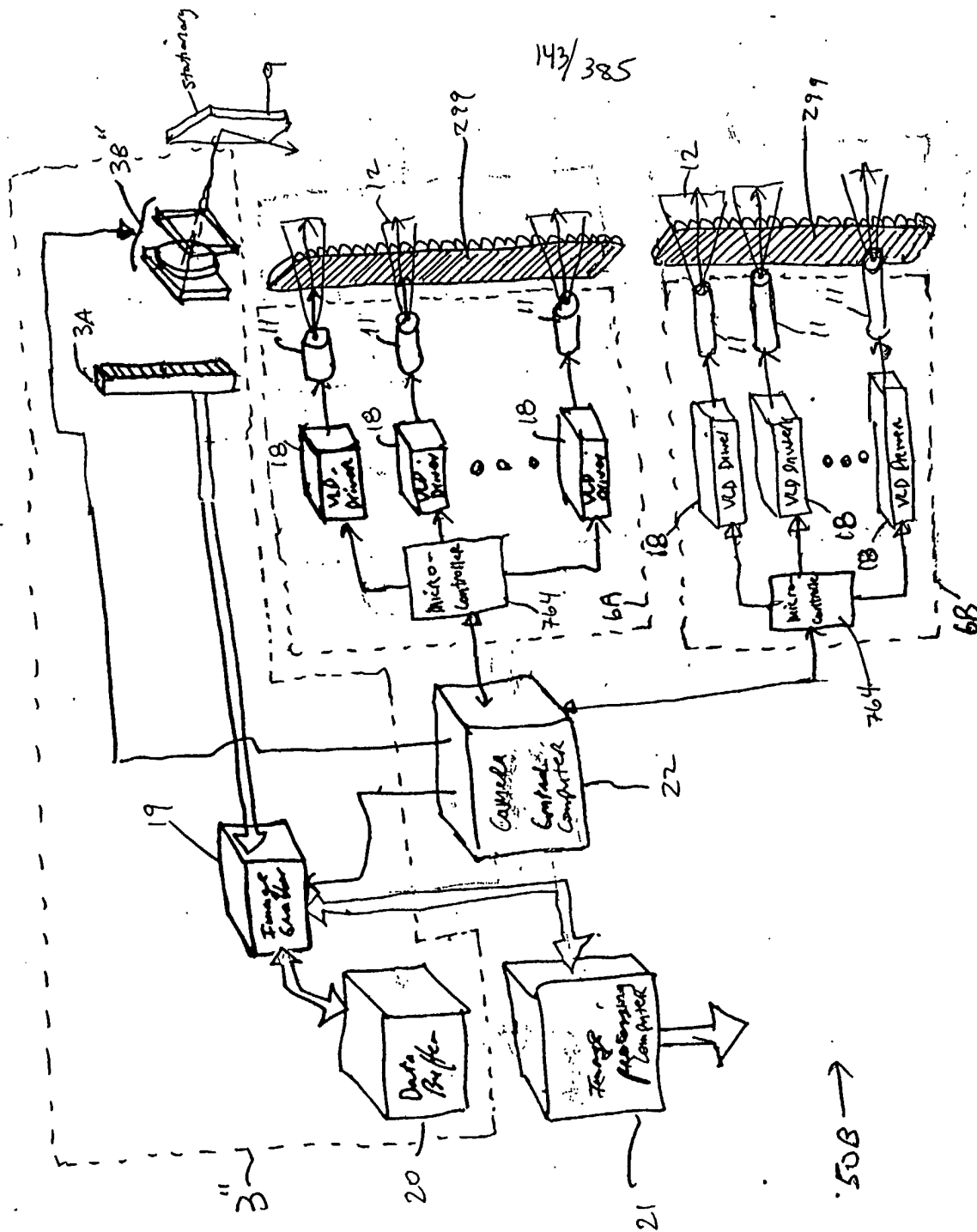


FIG 3E1

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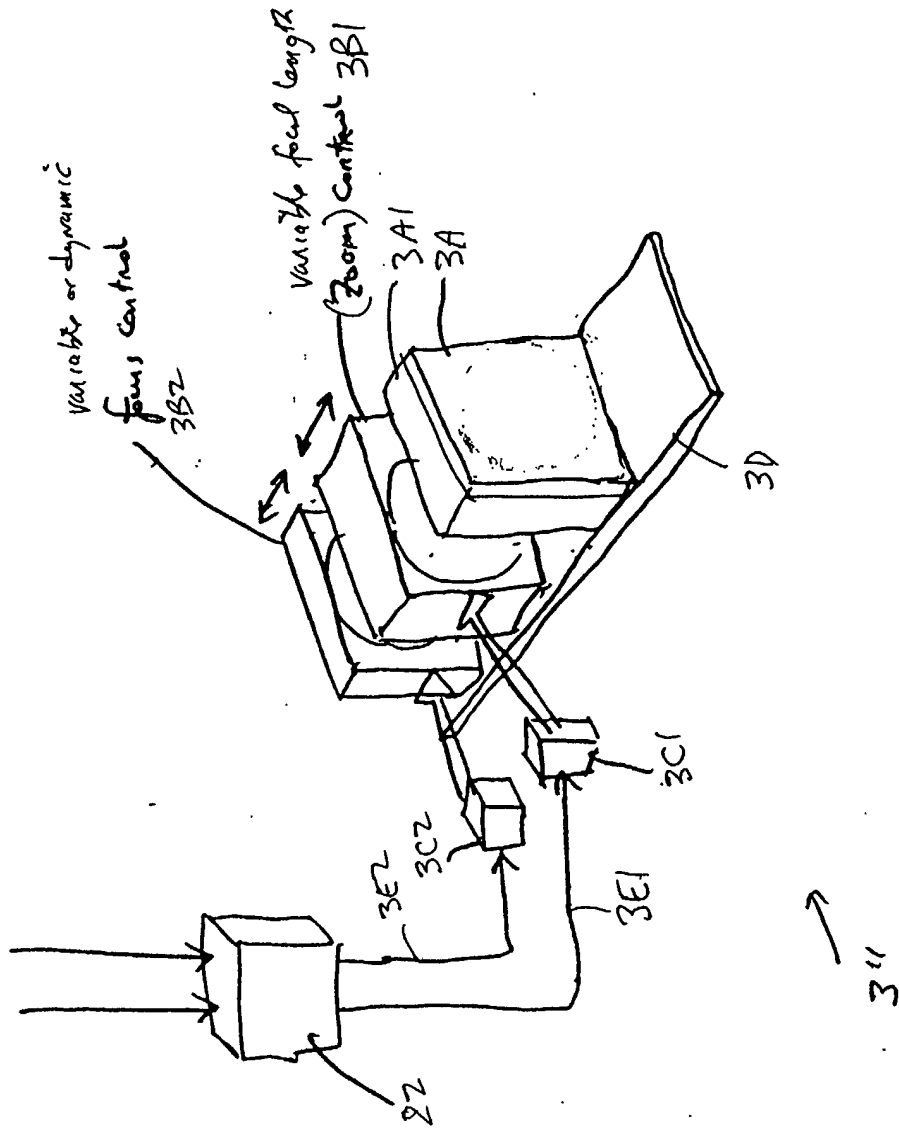
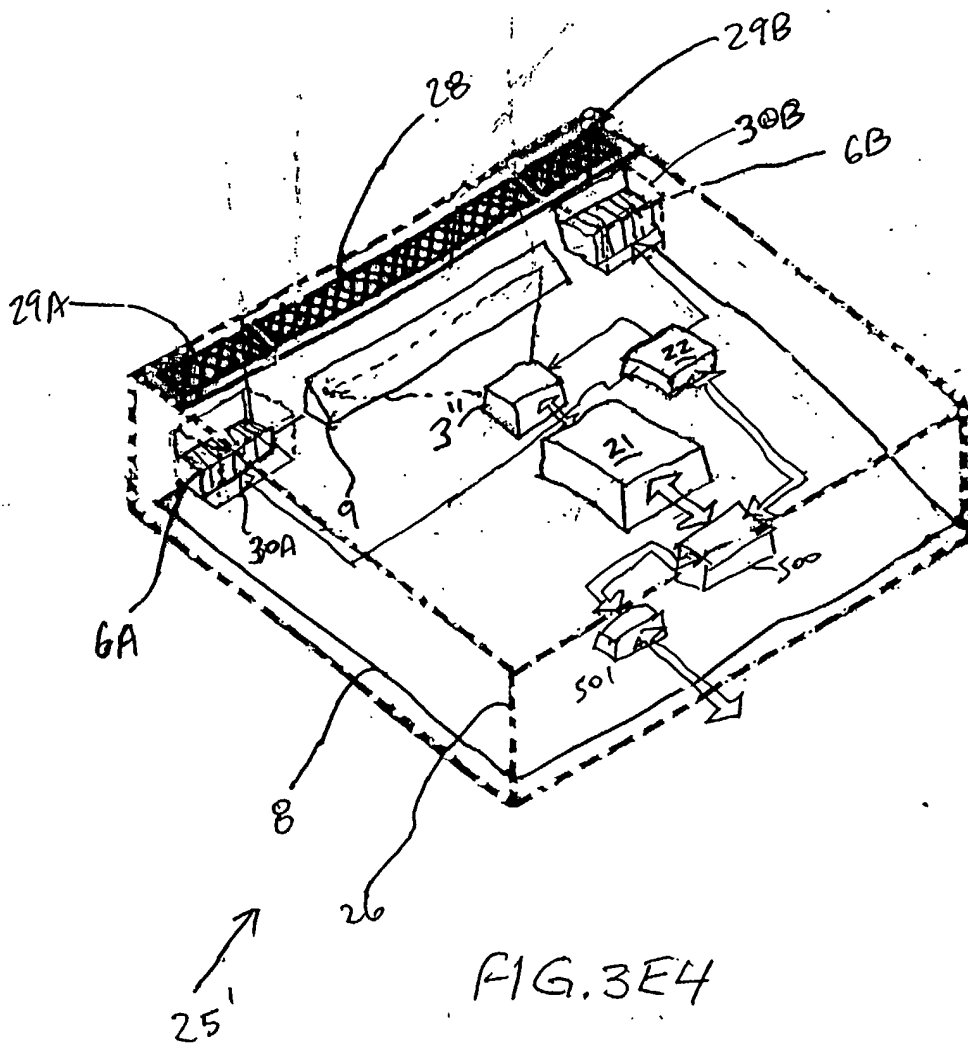


FIG. 3E3

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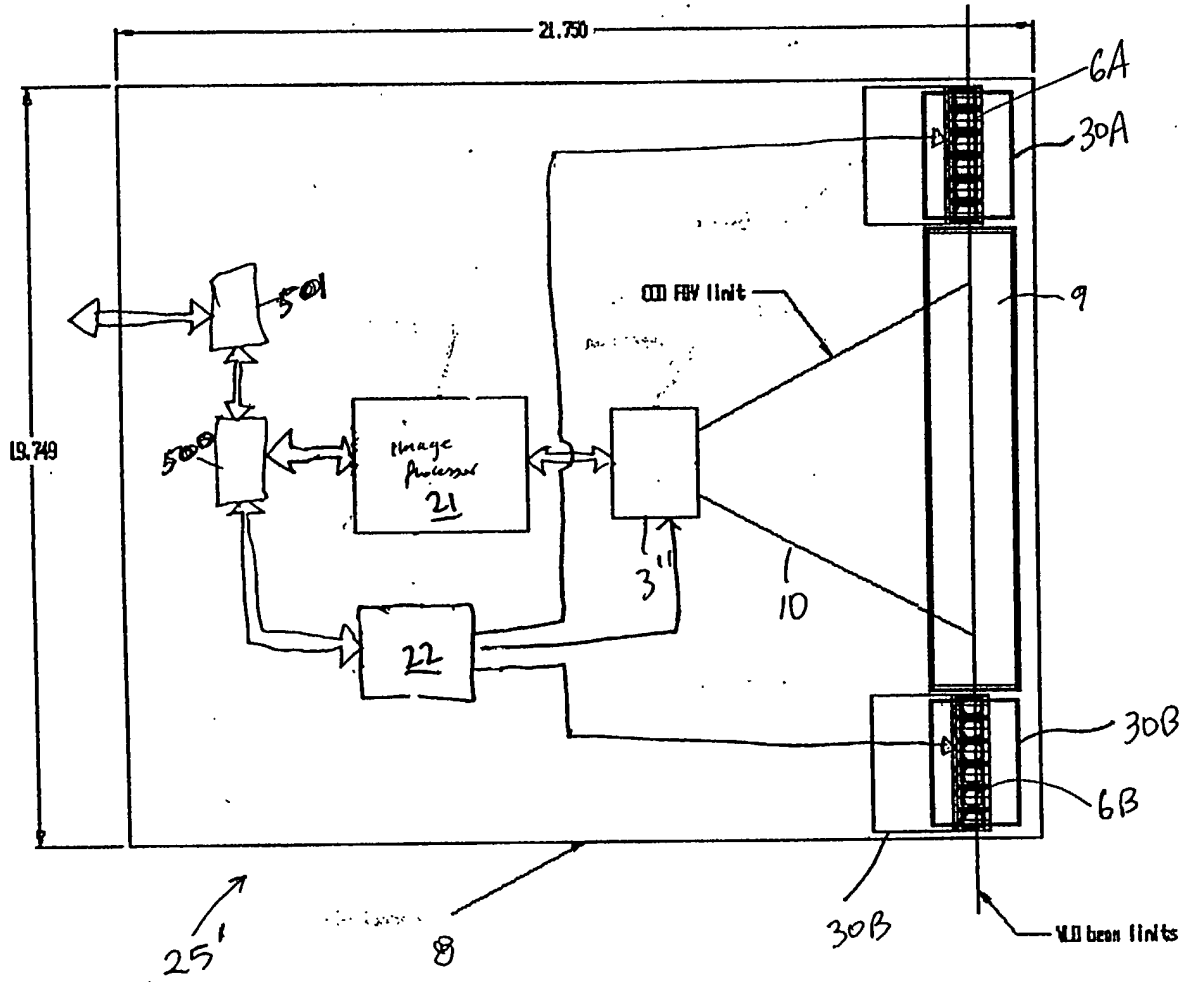


FIG. 3E5

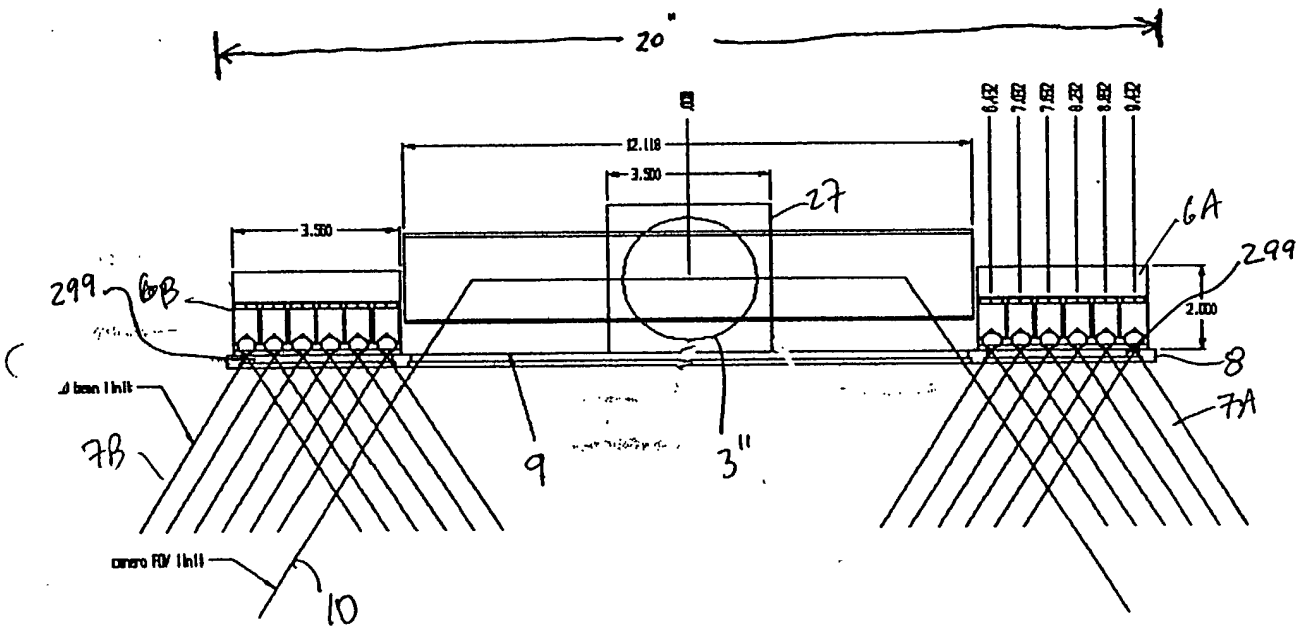
$$147 \overline{) 385}$$


FIG. 3E6

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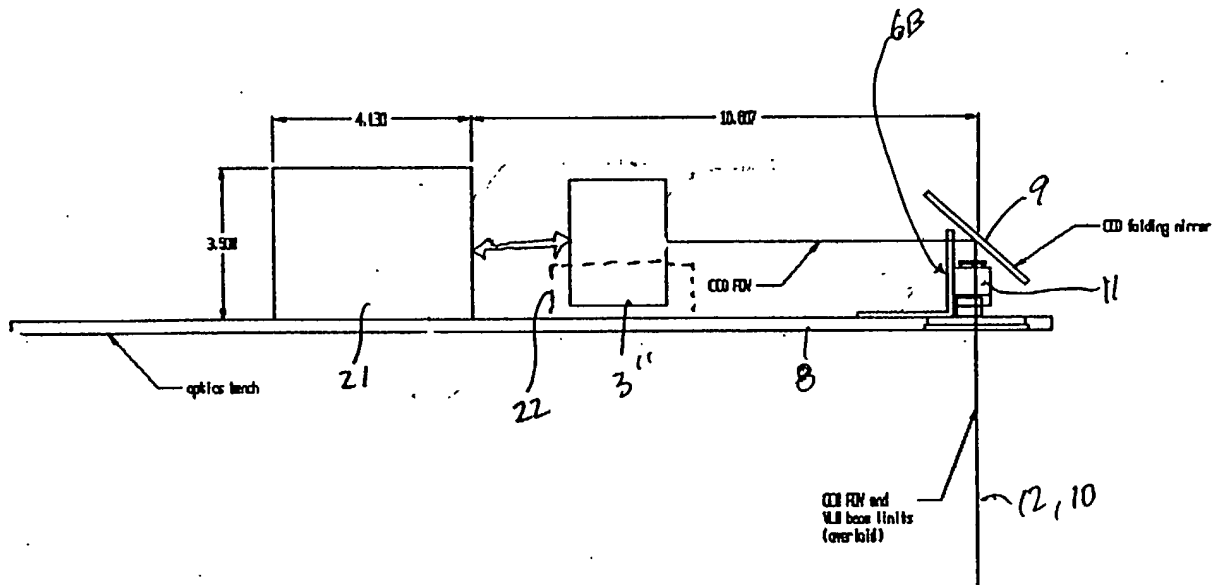


FIG. 3E7

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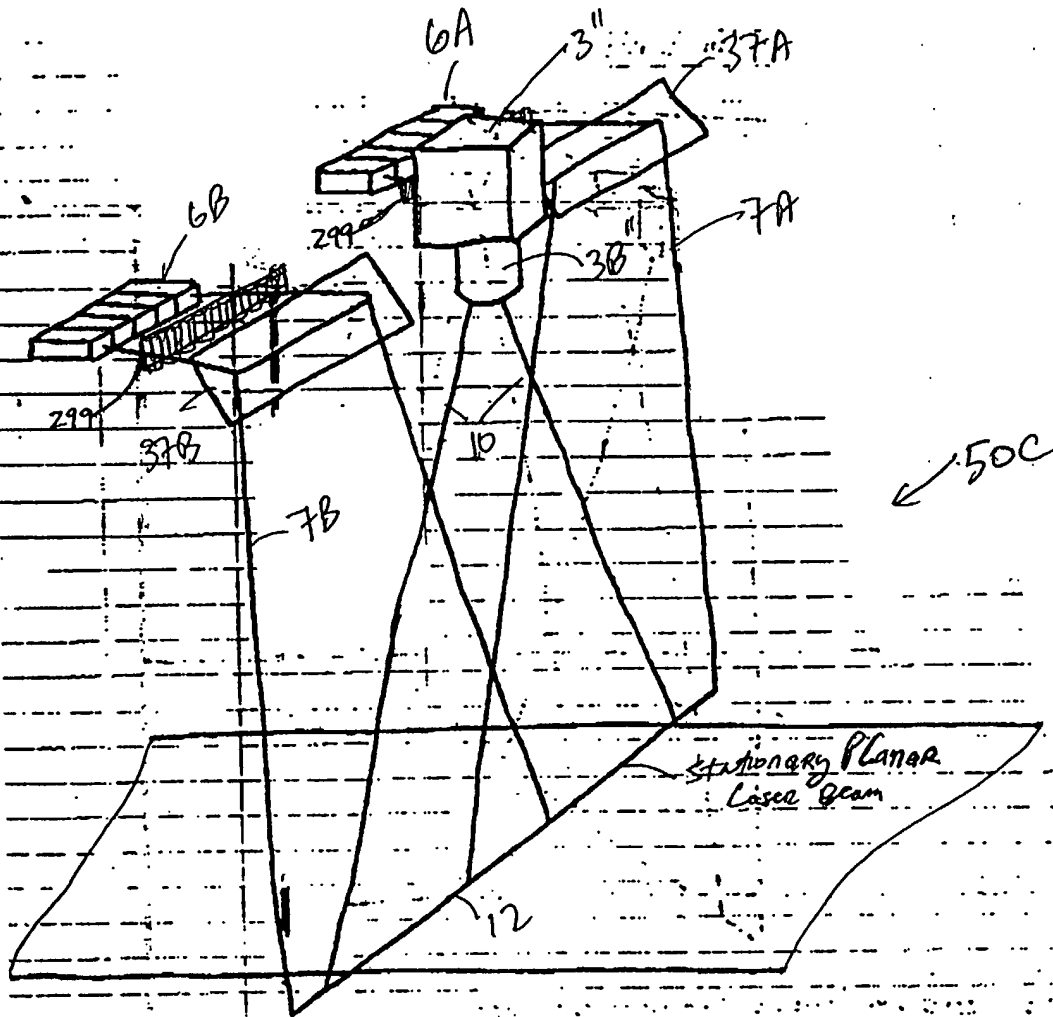
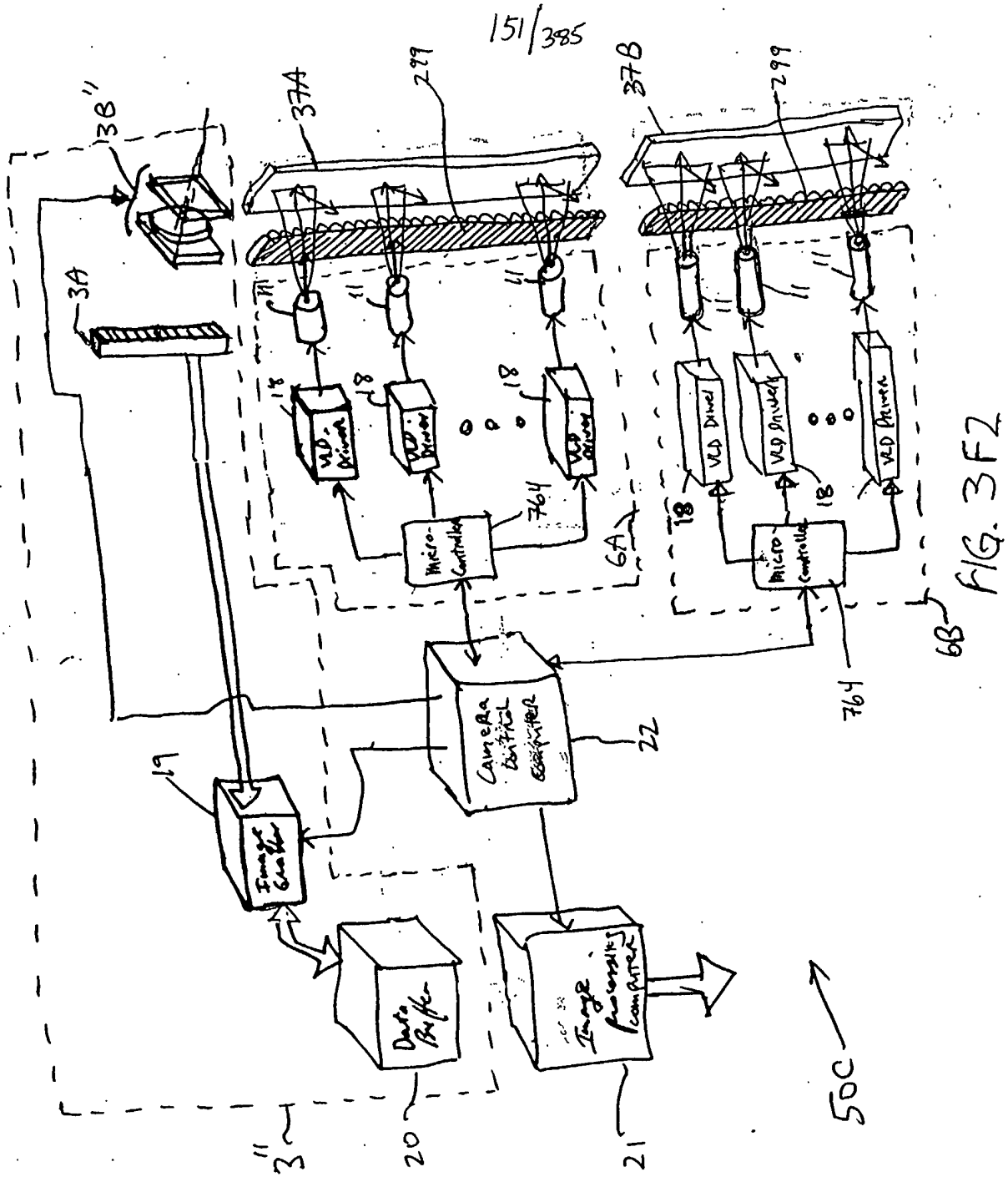


FIG. 3F1



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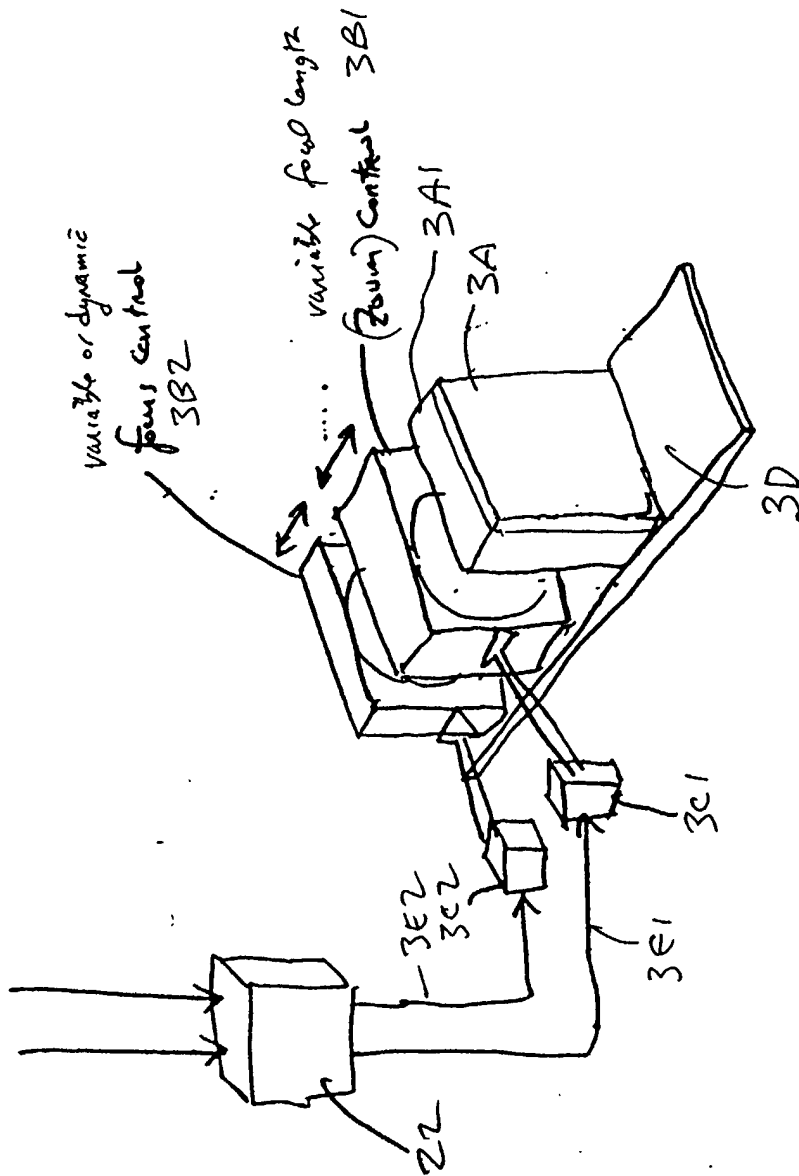


FIG. 3F3

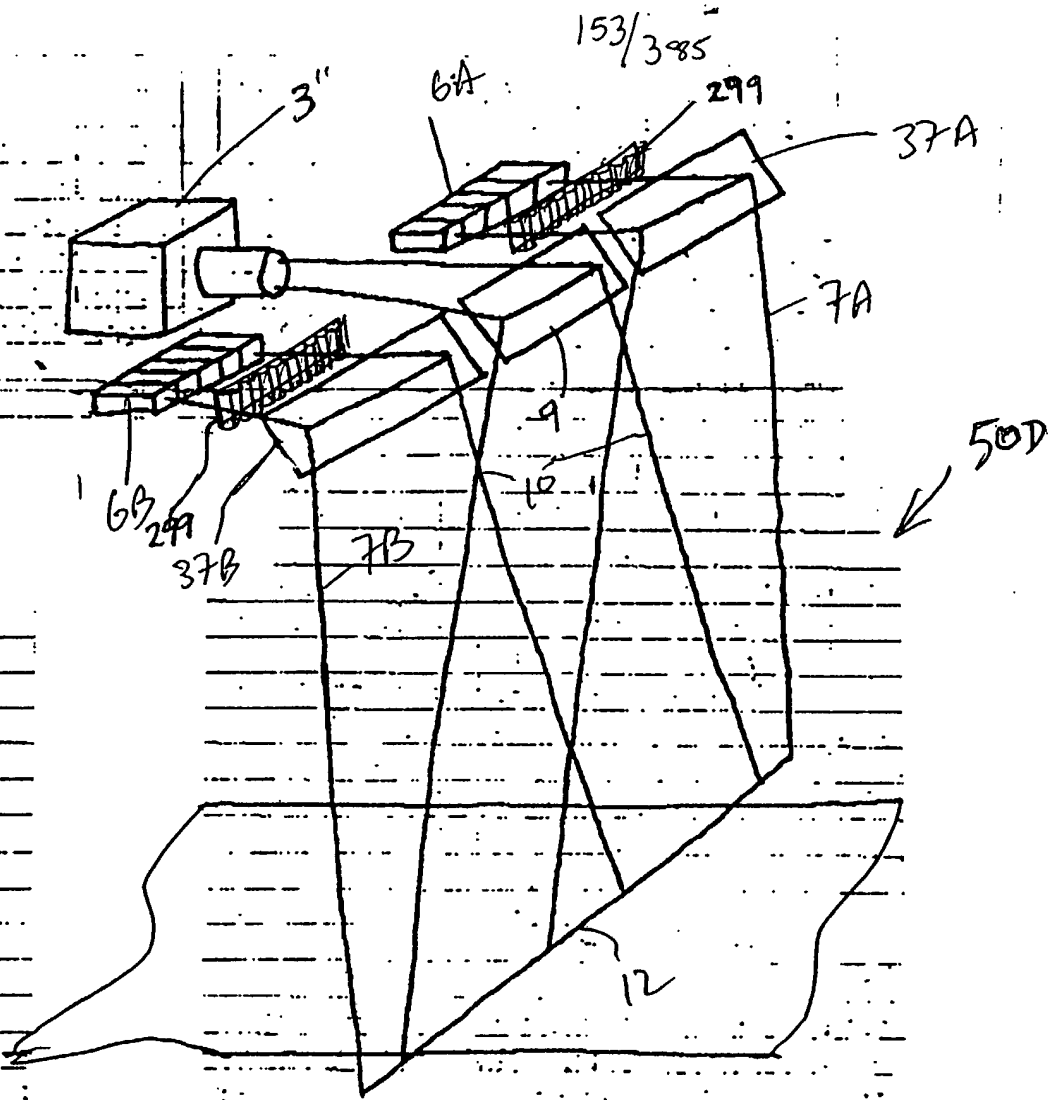
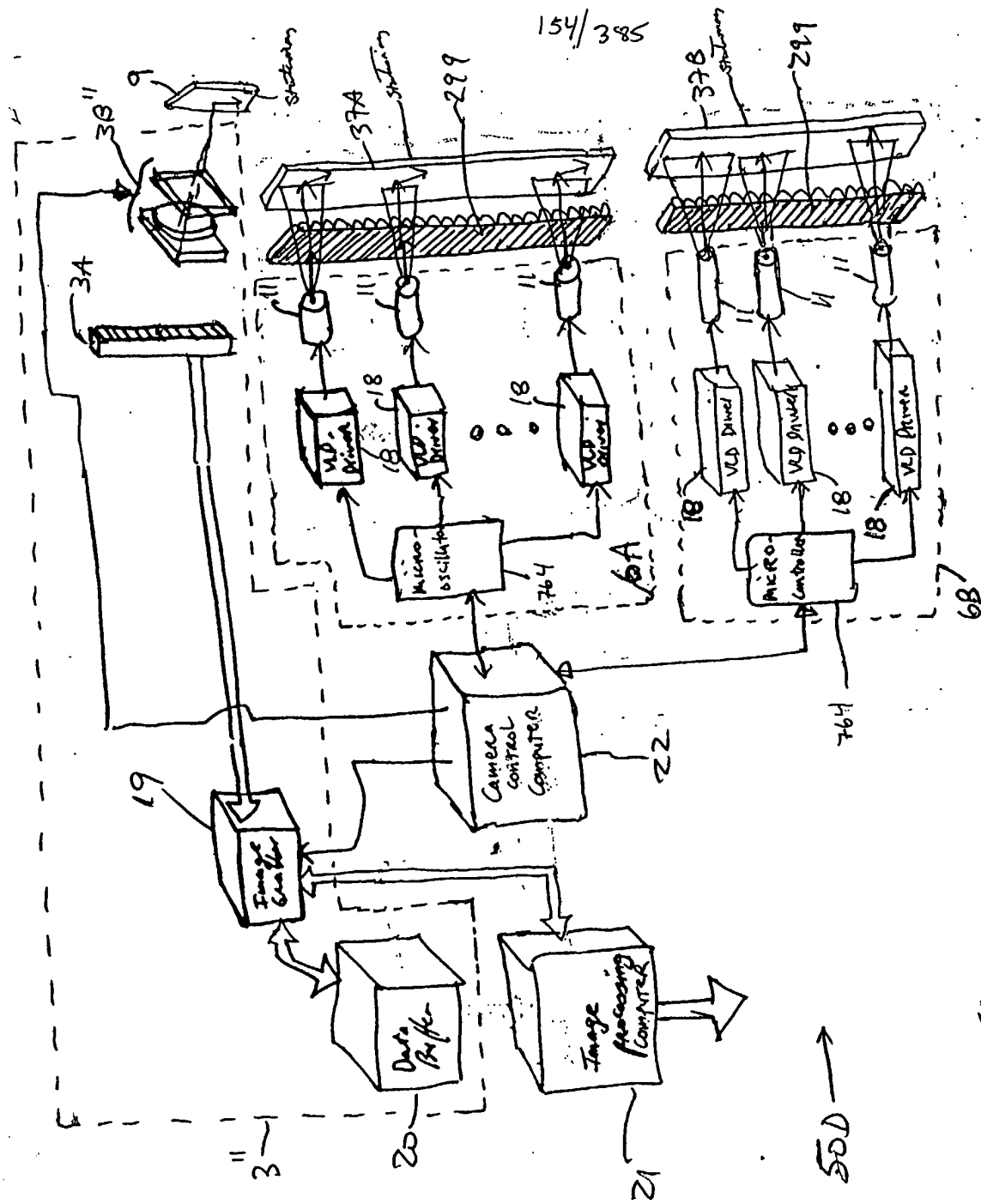


FIG. 3G1



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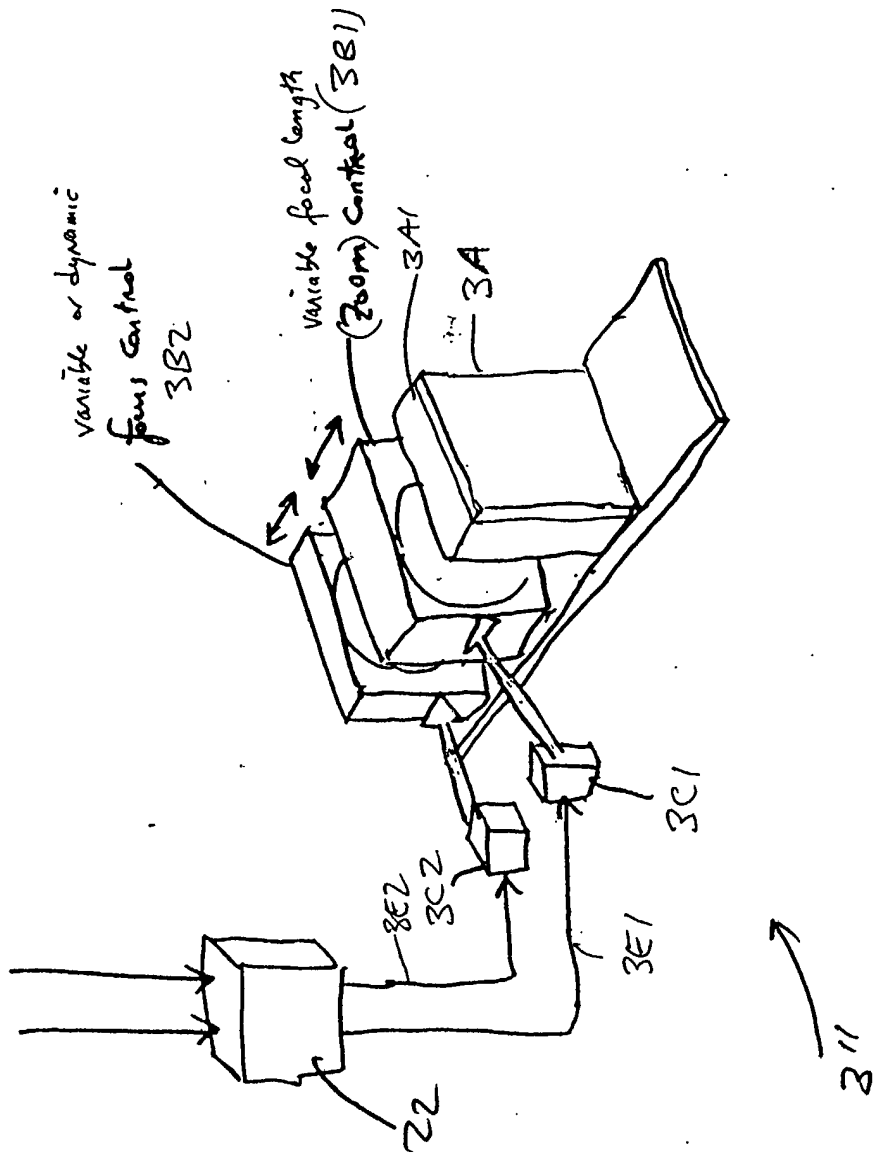


FIG. 3G3

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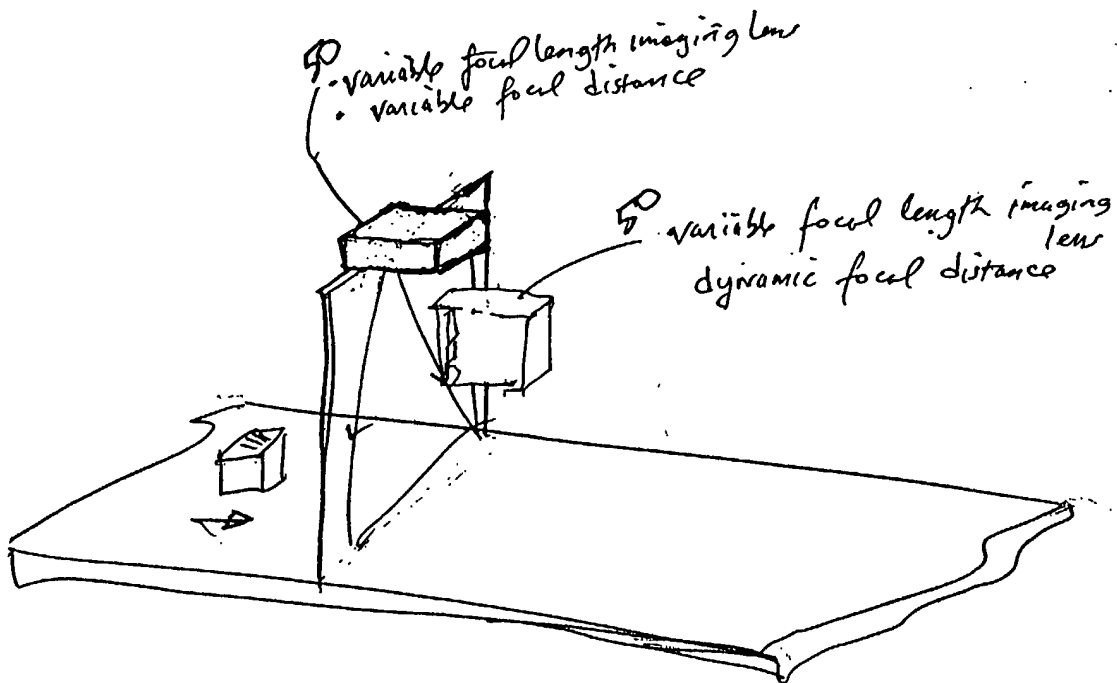


FIG. 3H

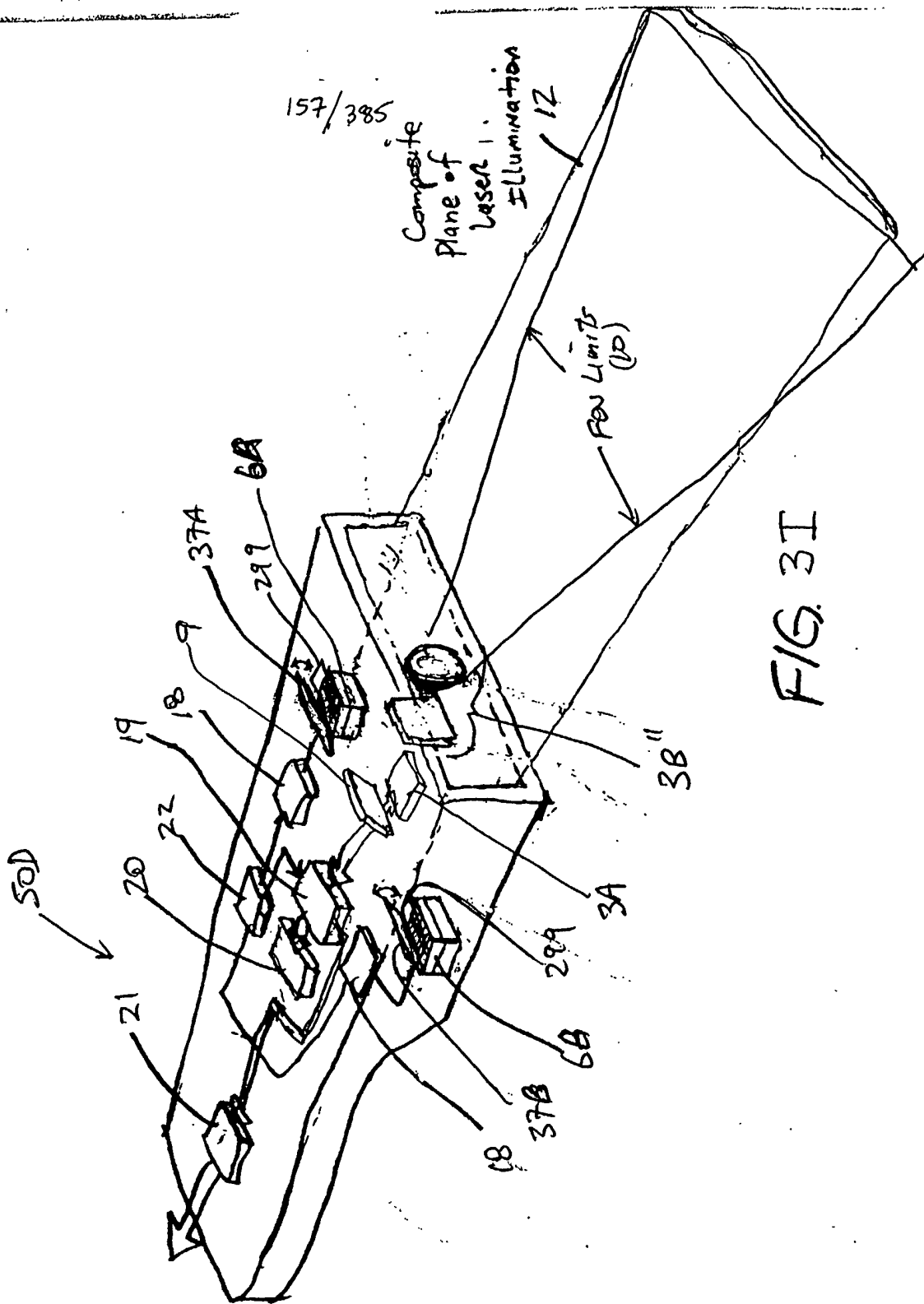


FIG. 3I

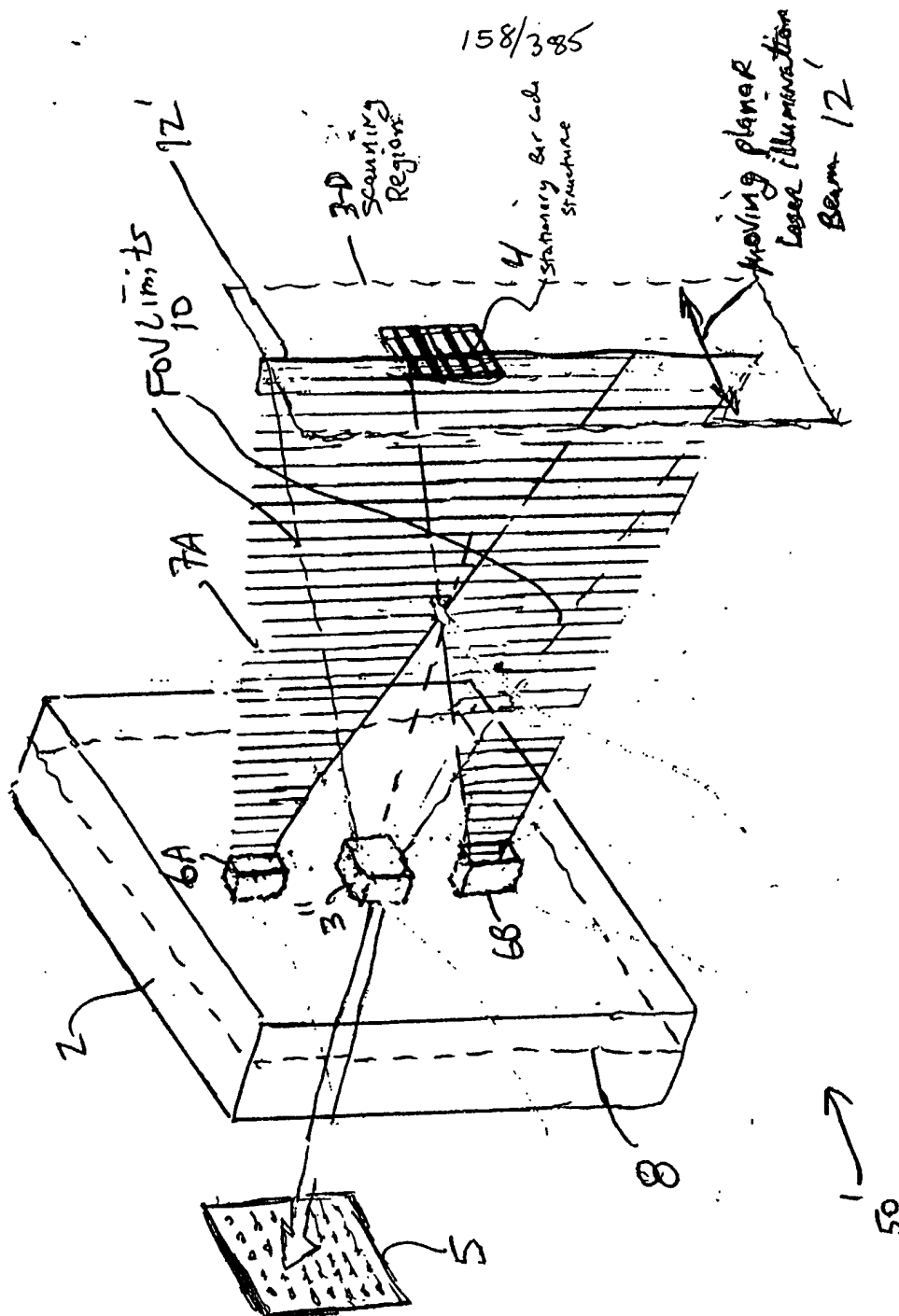


FIG. 3J1

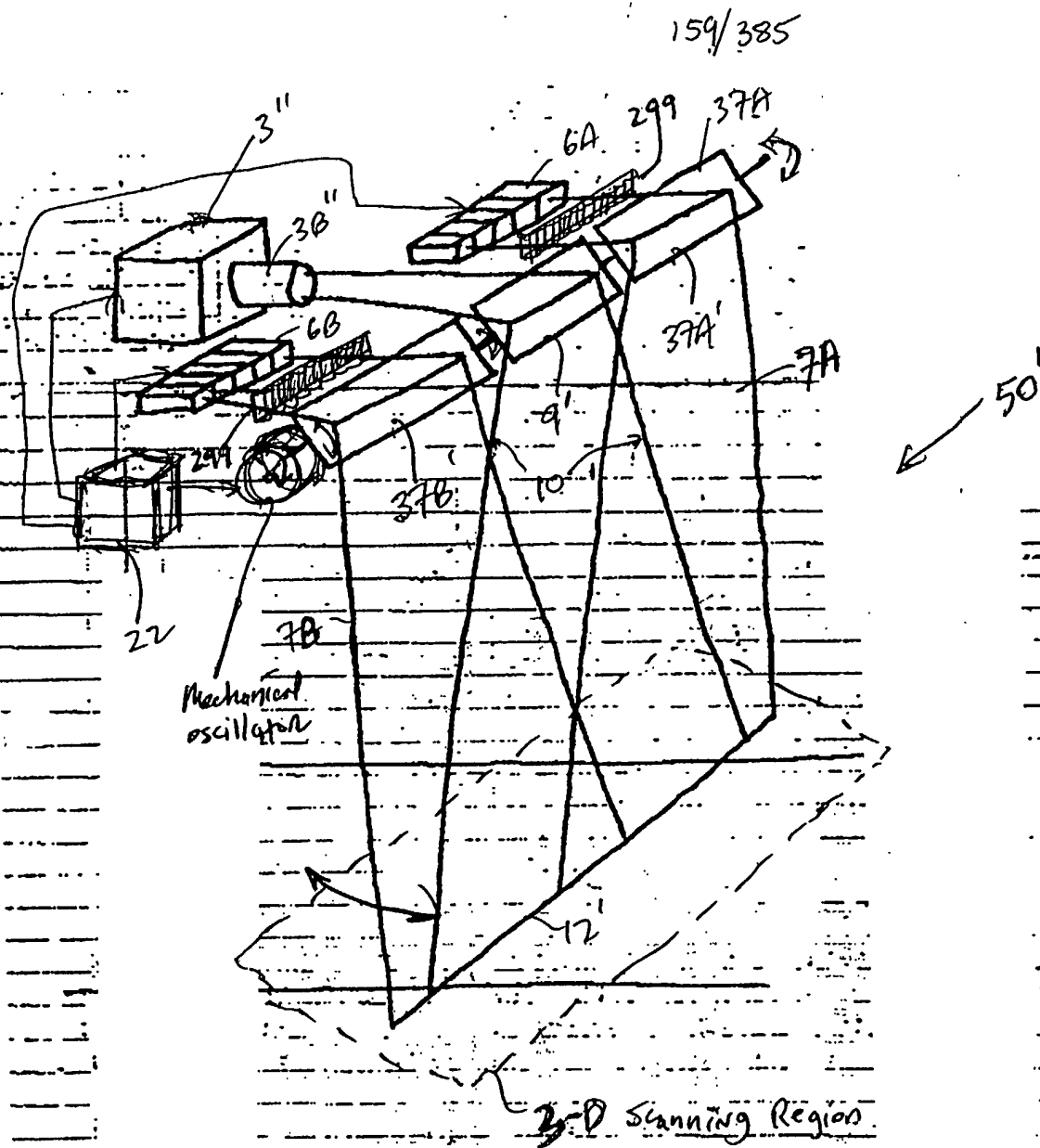


FIG. 3J2

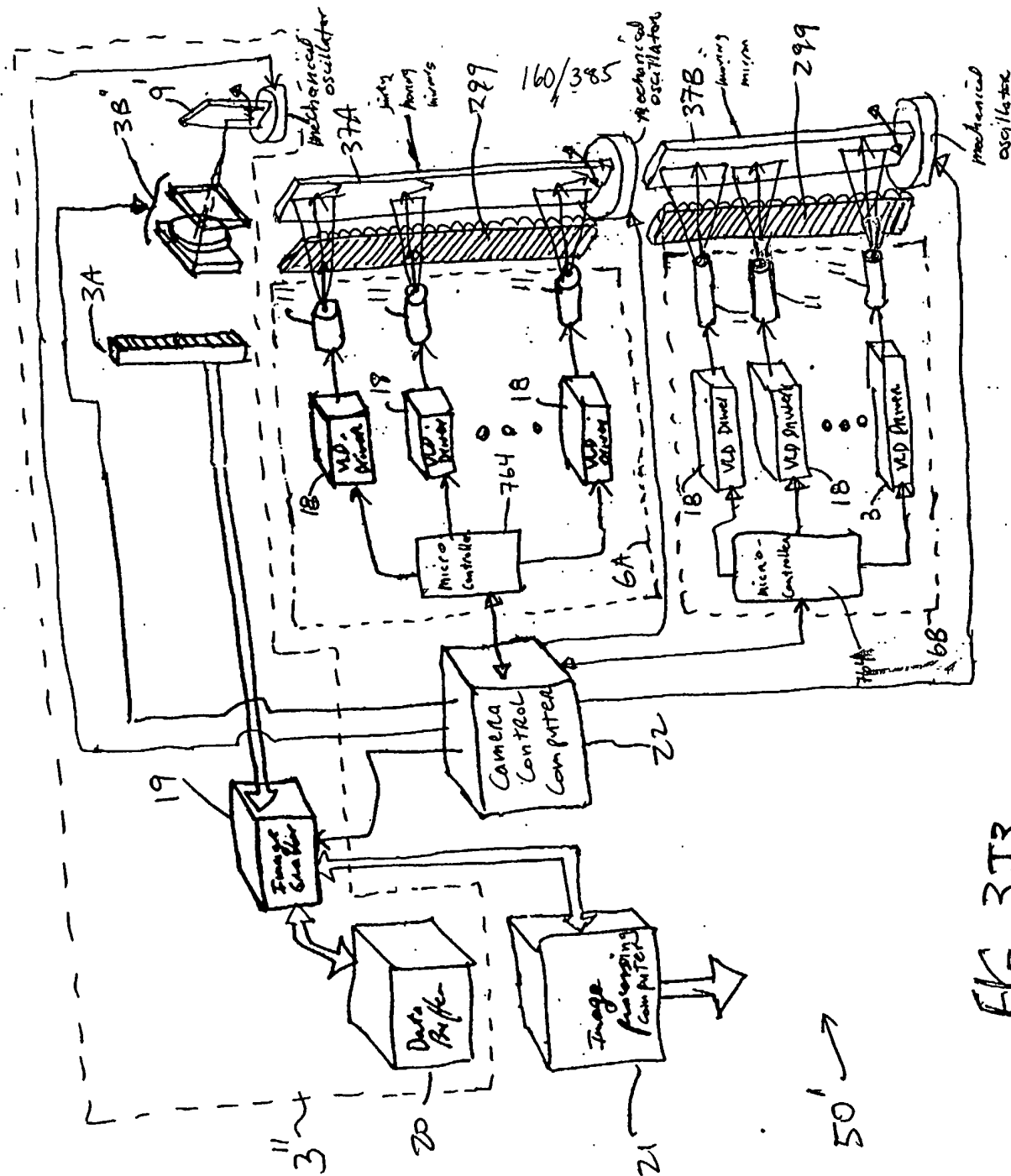


FIG. 3J3

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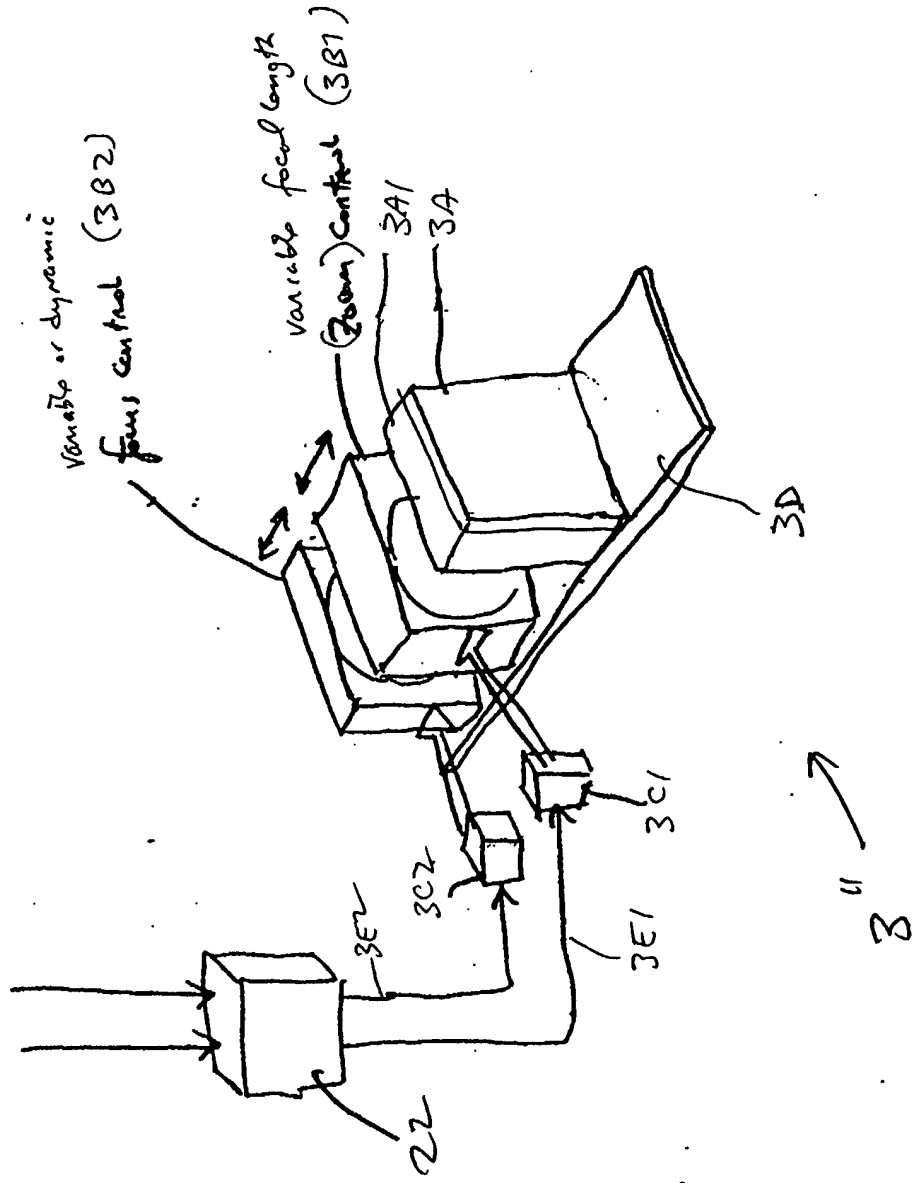


FIG. 3J4

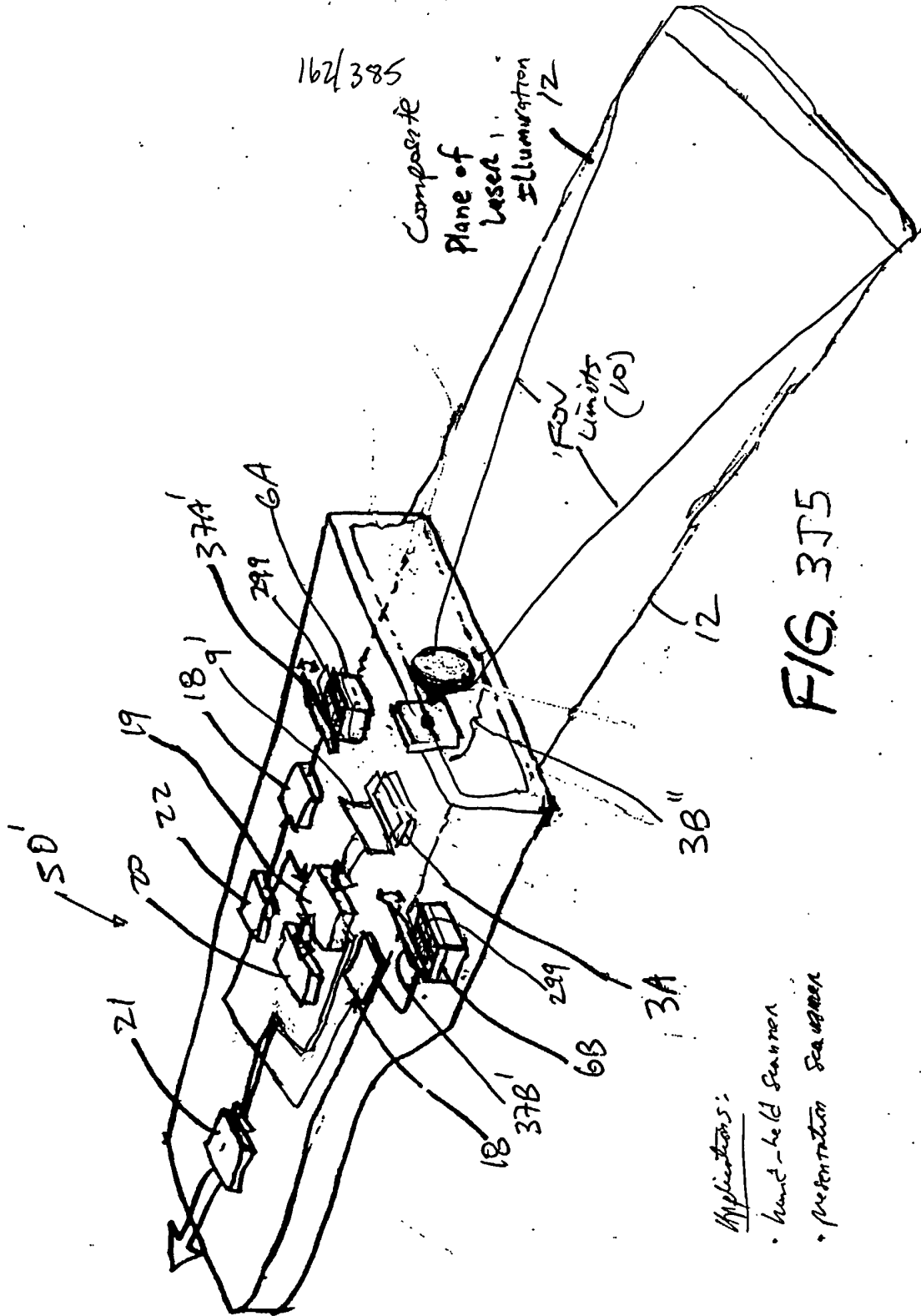


FIG. 3J5

- Applications:
- hand-held scanner
 - presentation scanner

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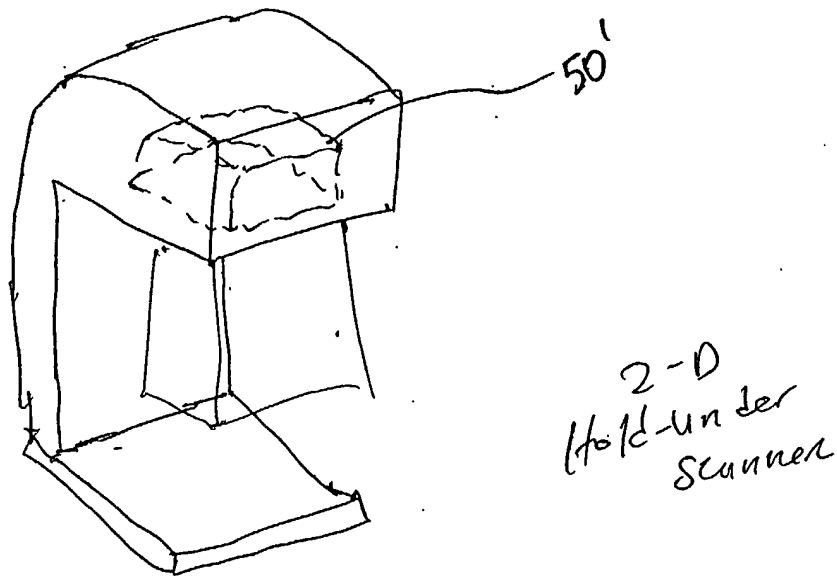


FIG-3J6

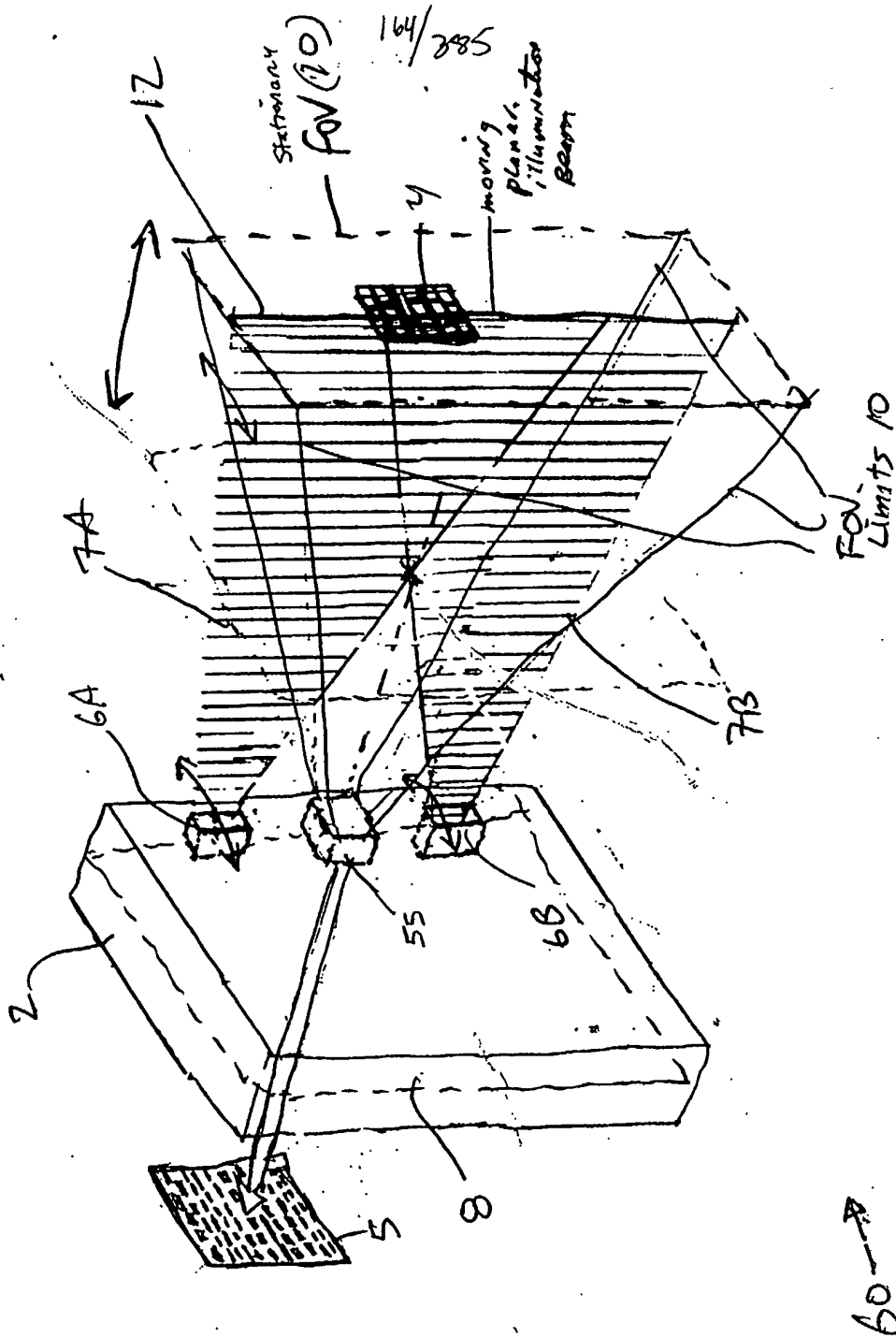


FIG 4A

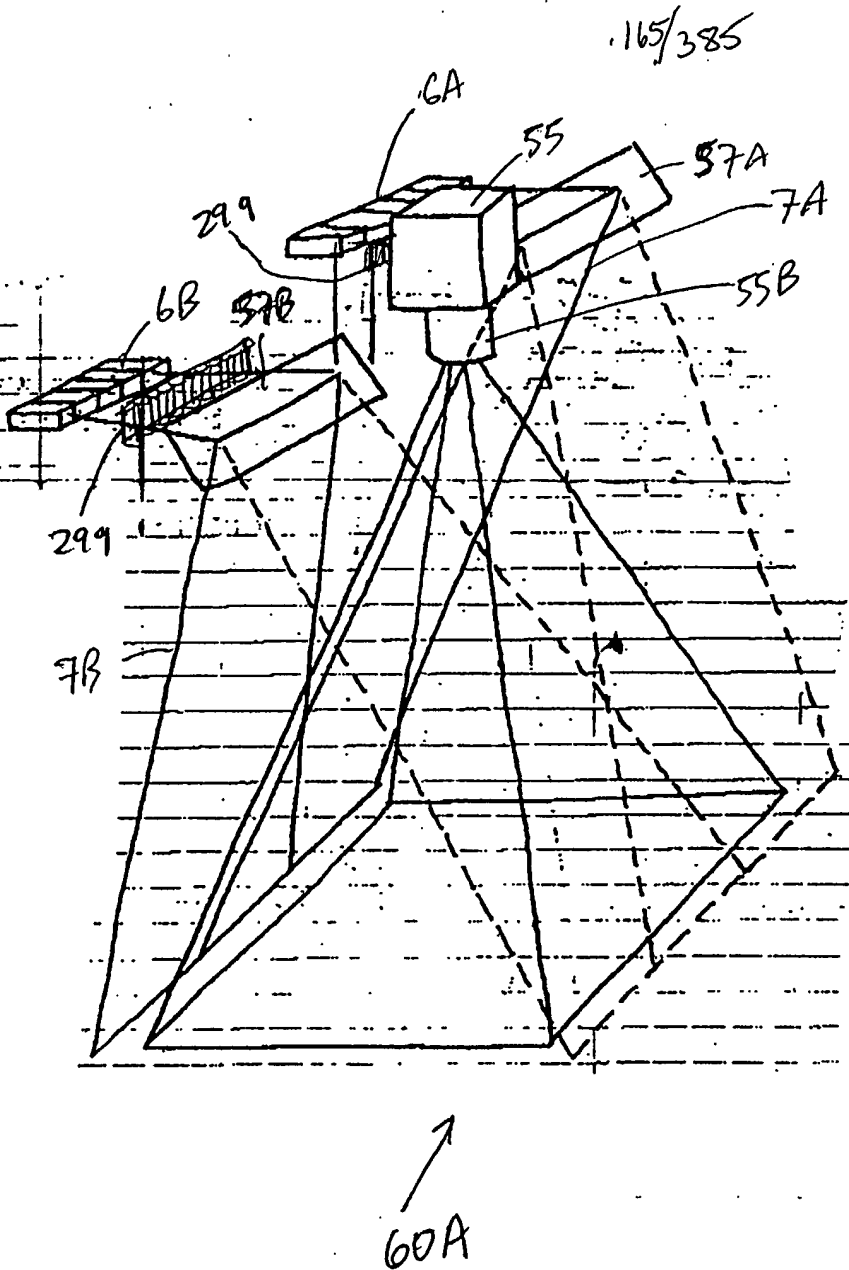


FIG. 4B1

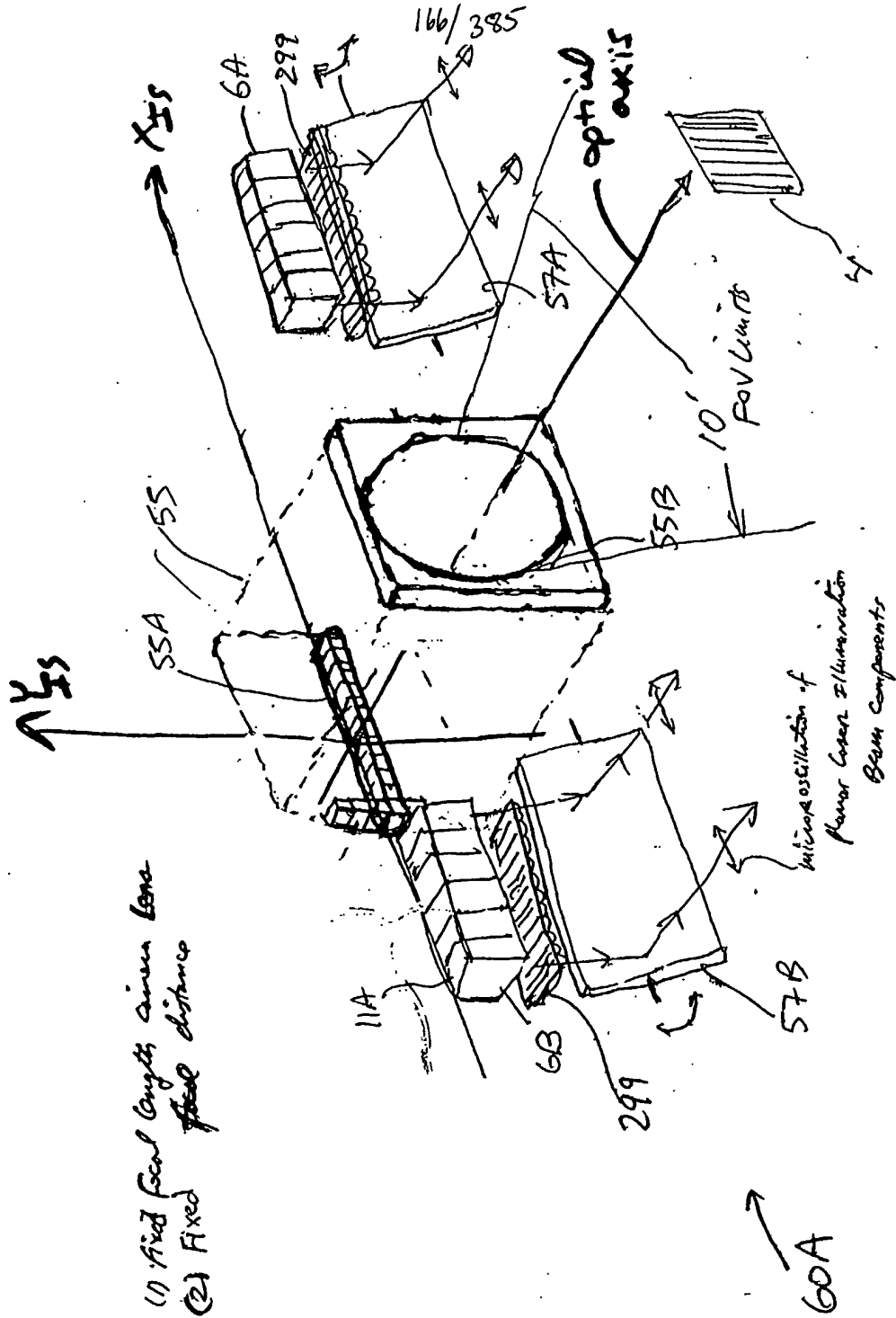
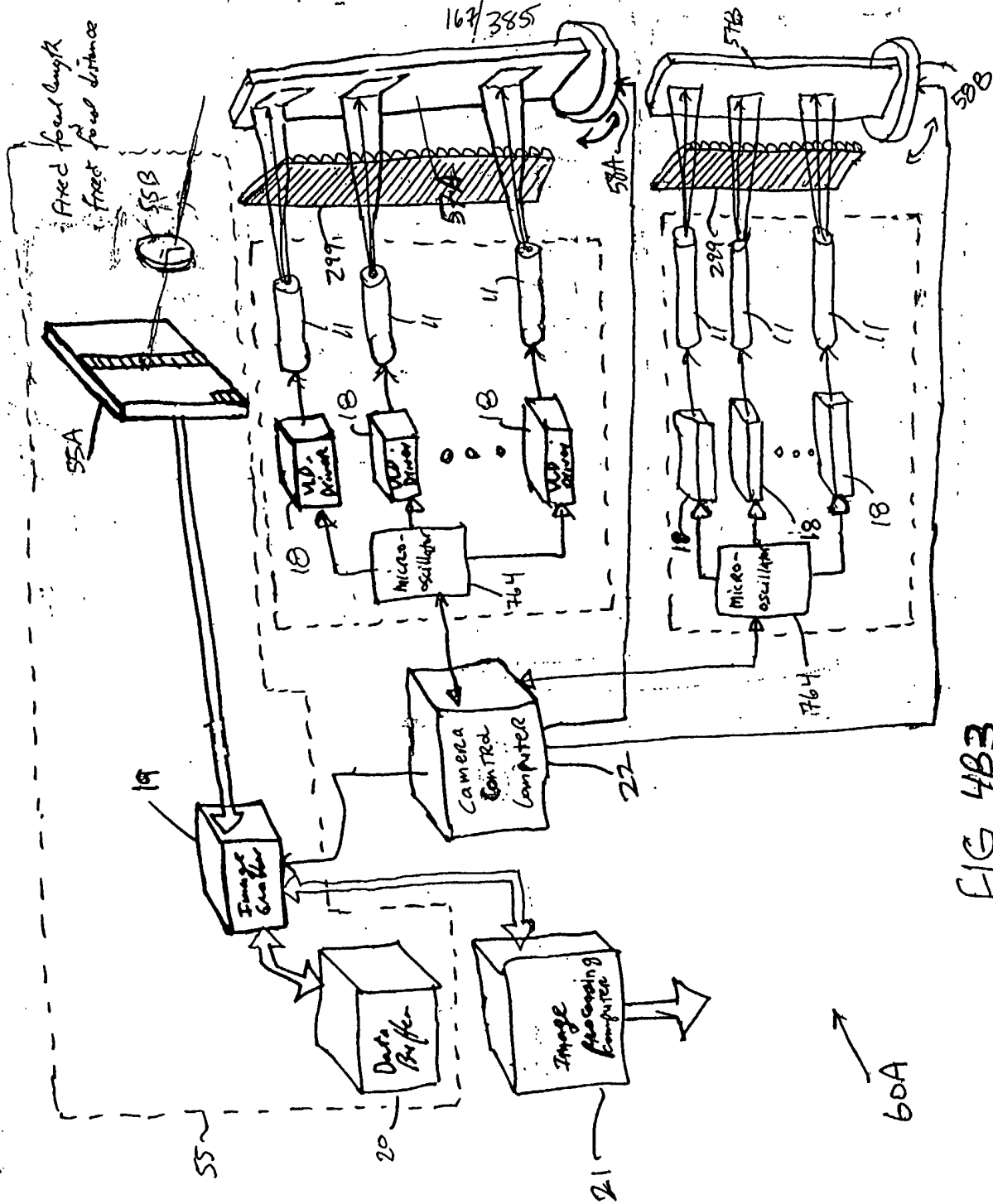


FIG. 4B.2

- (1) Fixed focal length lens
- (2) Fixed focal distance



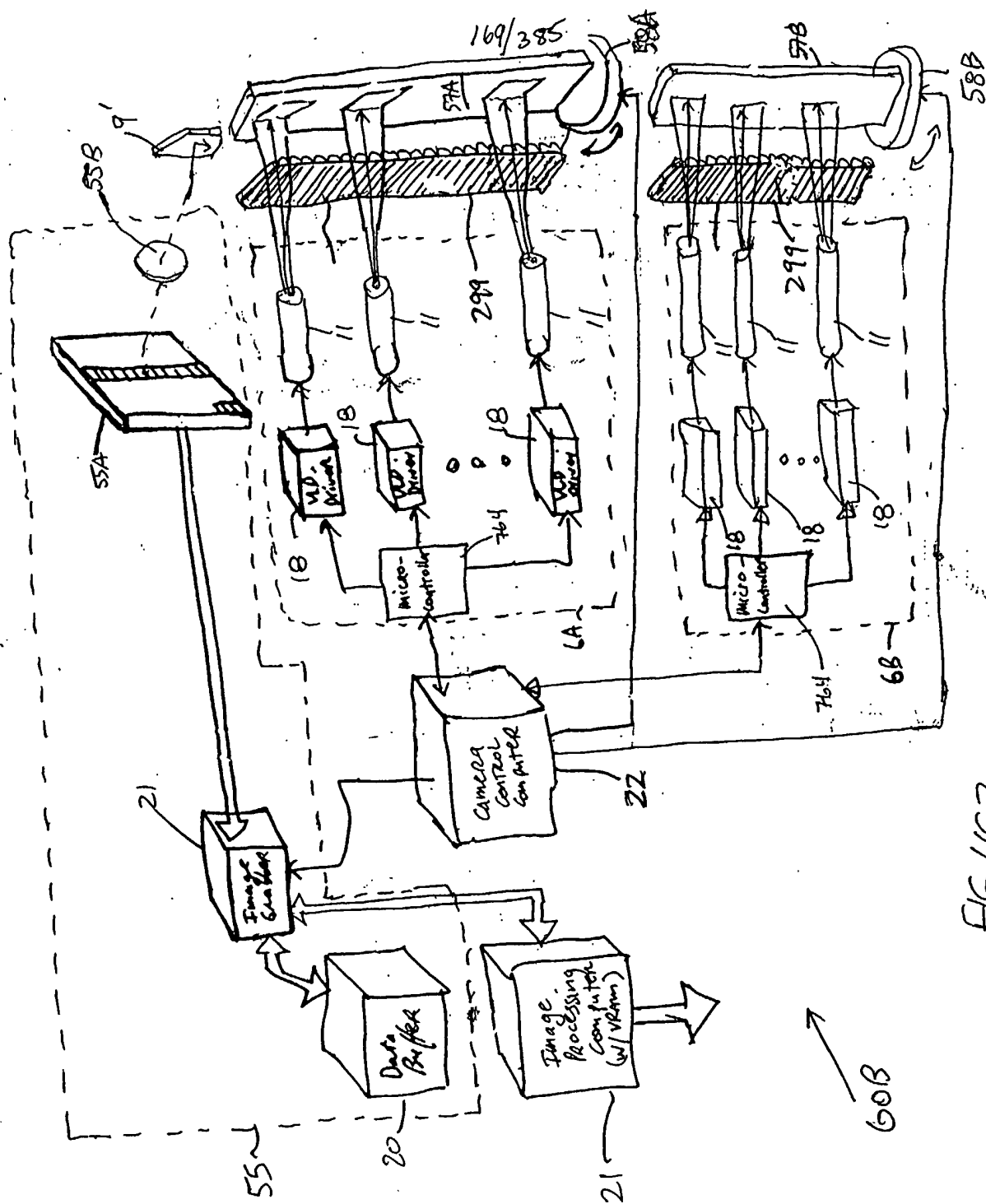


FIG 4C2

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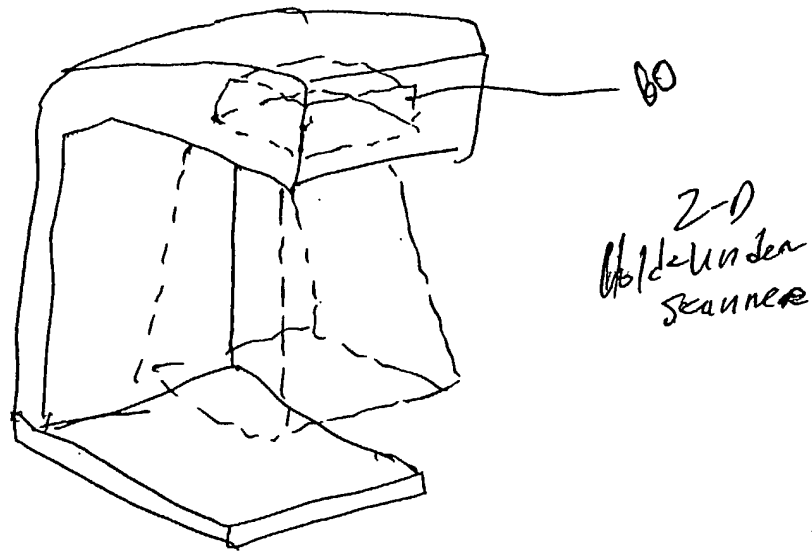
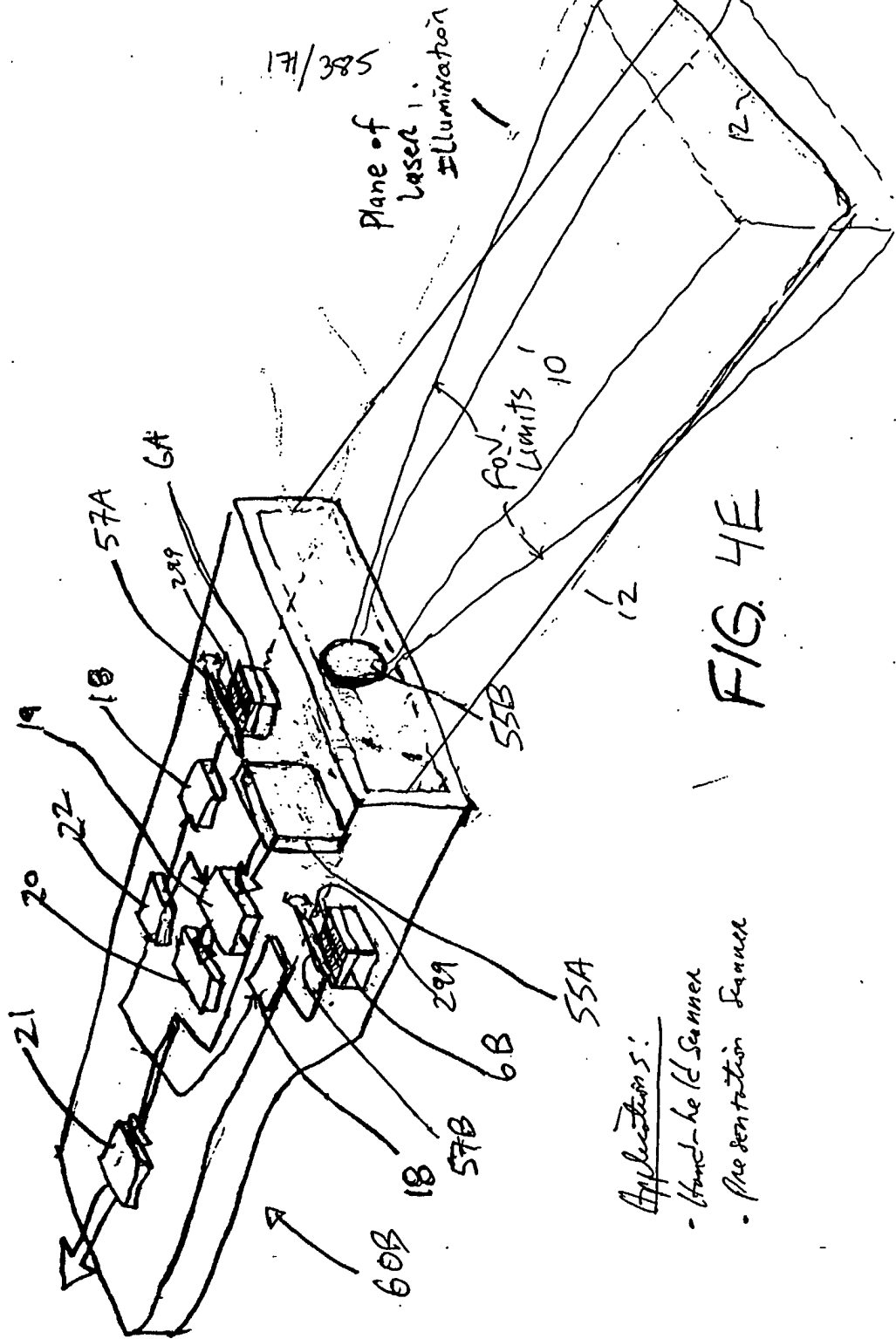


FIG. 4D



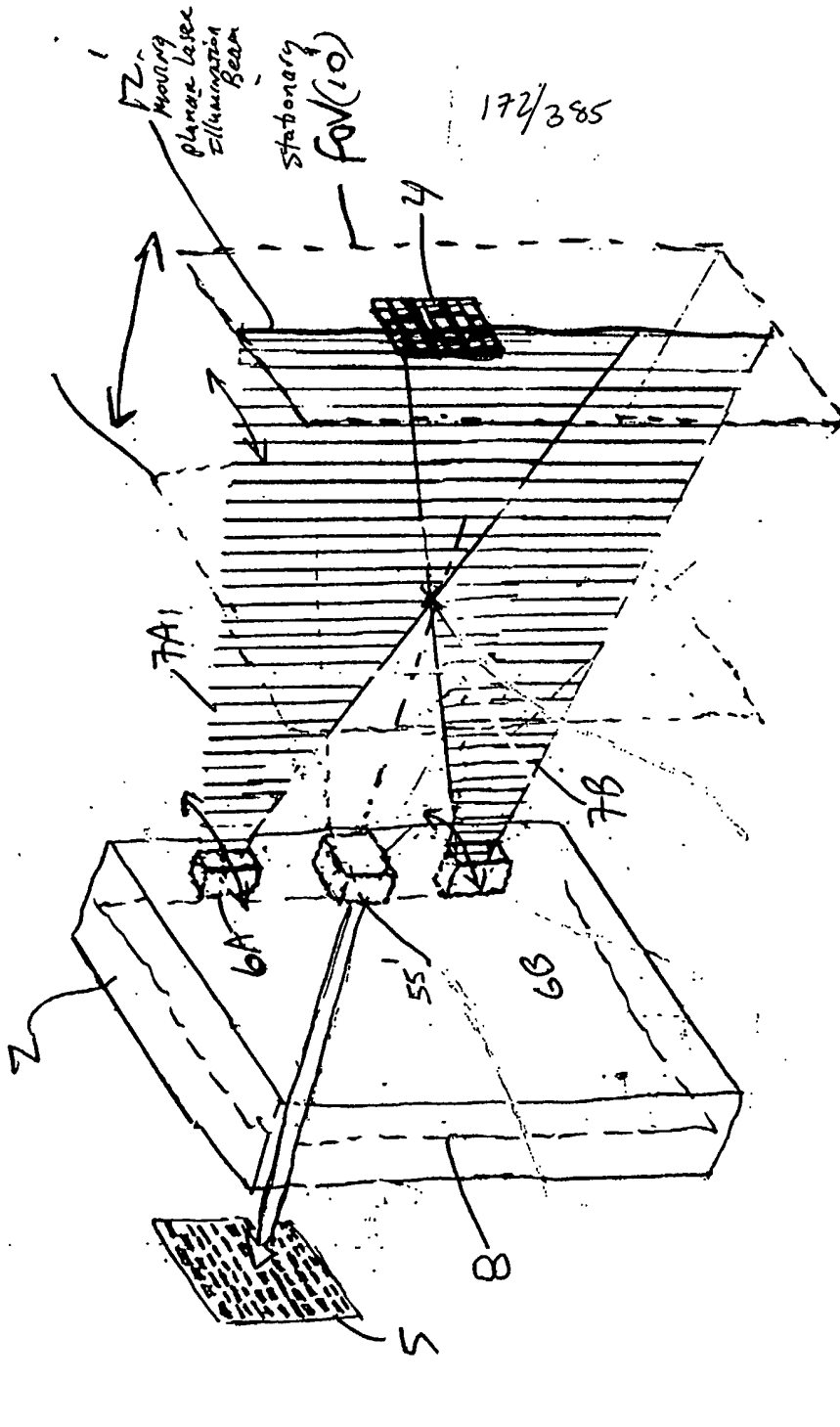


FIG. 5A

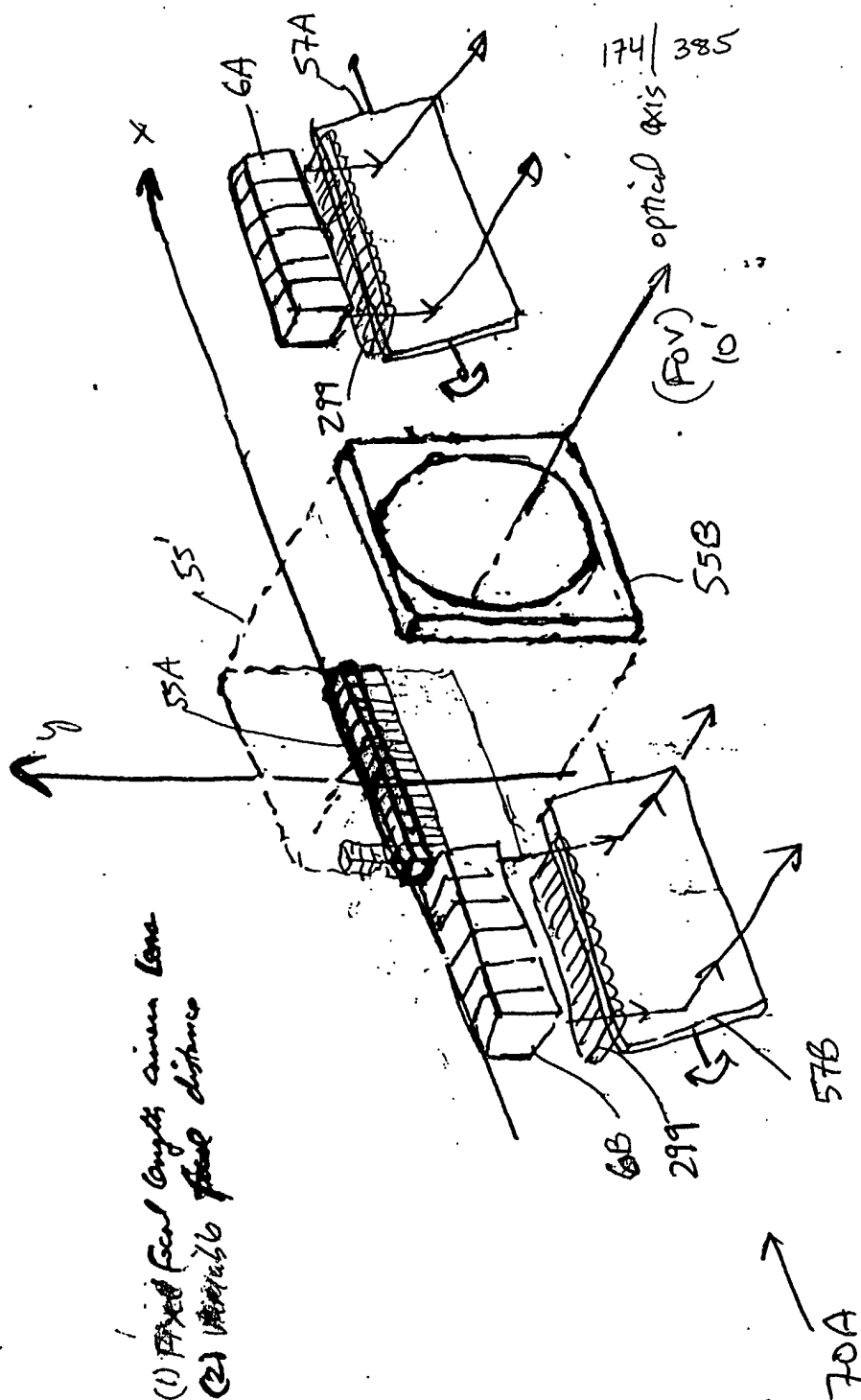


FIG. 5B2

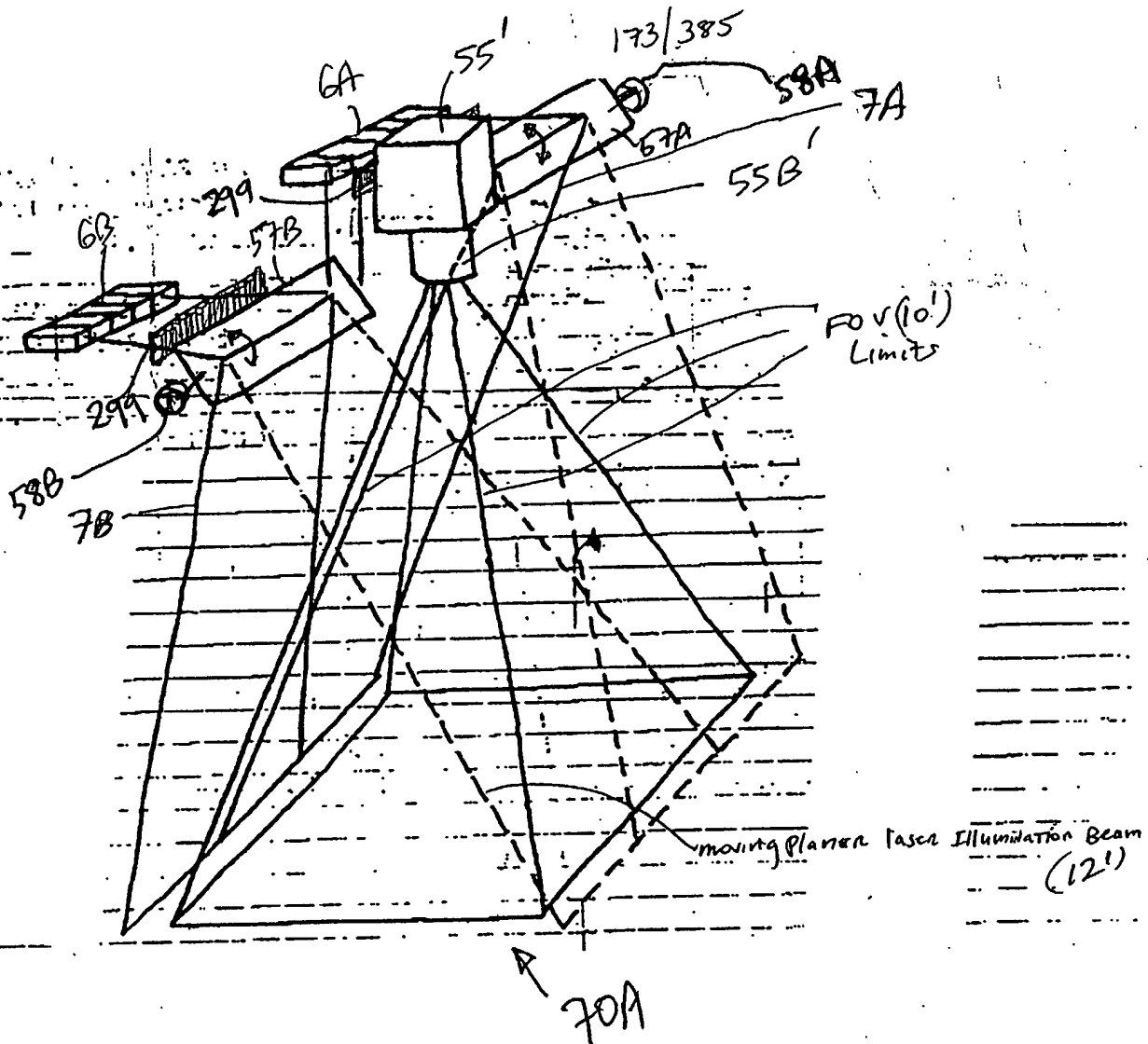


FIG 5B1

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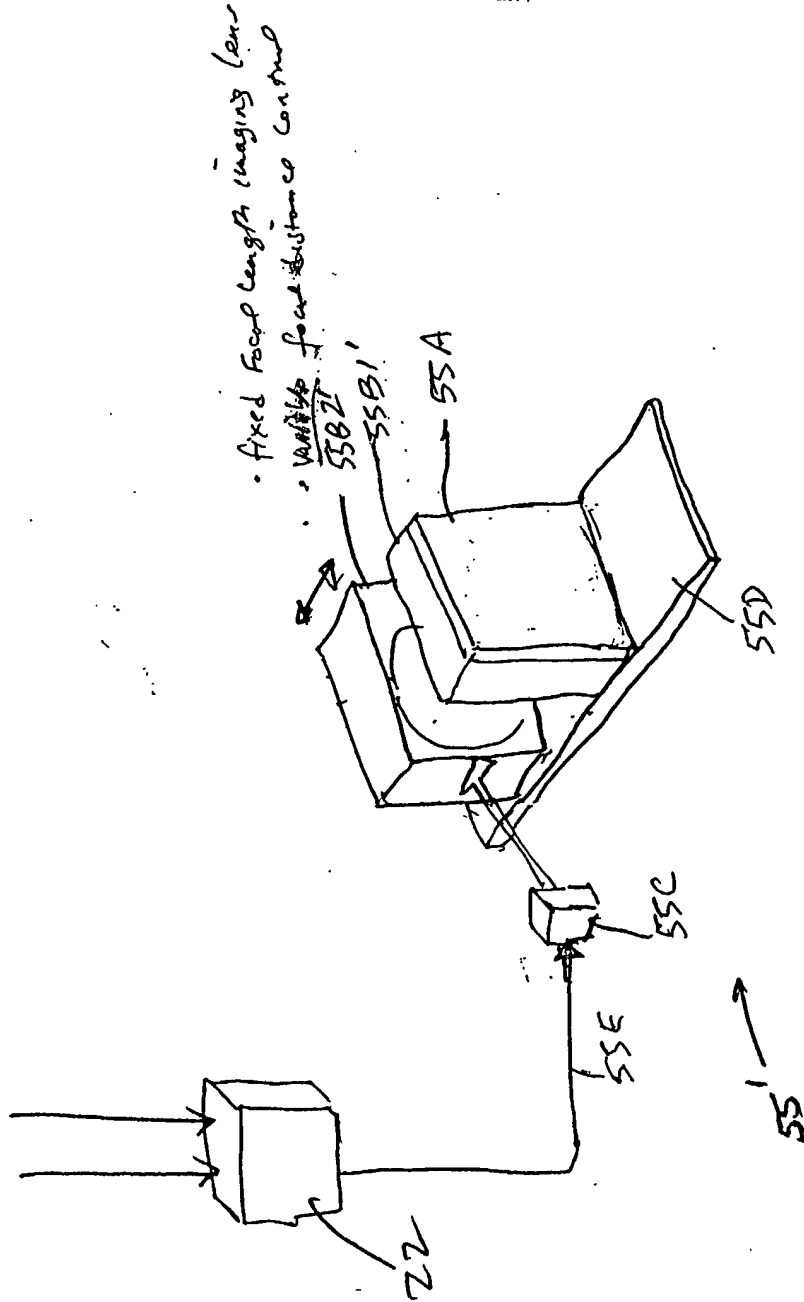


FIG. 5B4

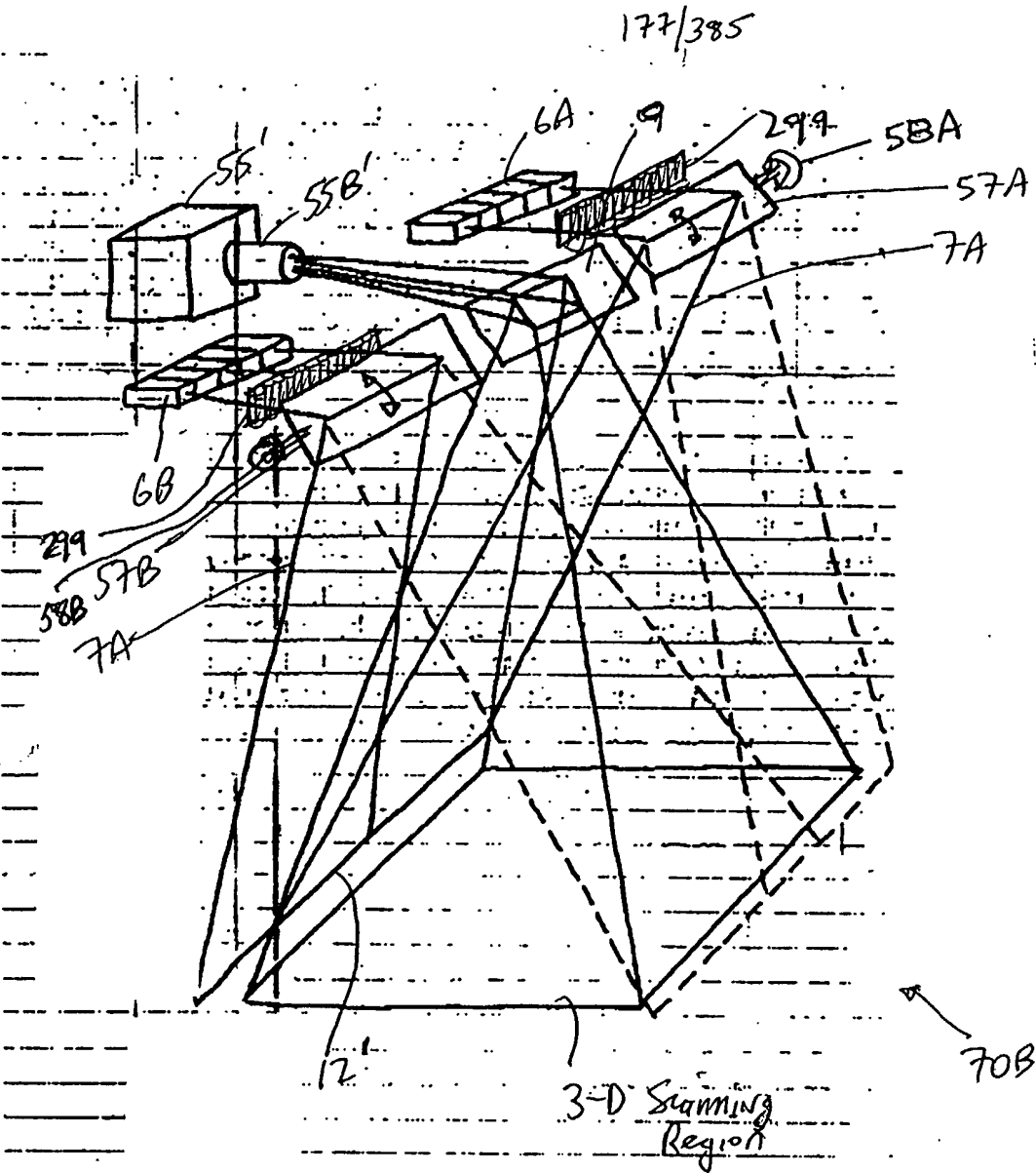


FIG. 5C1

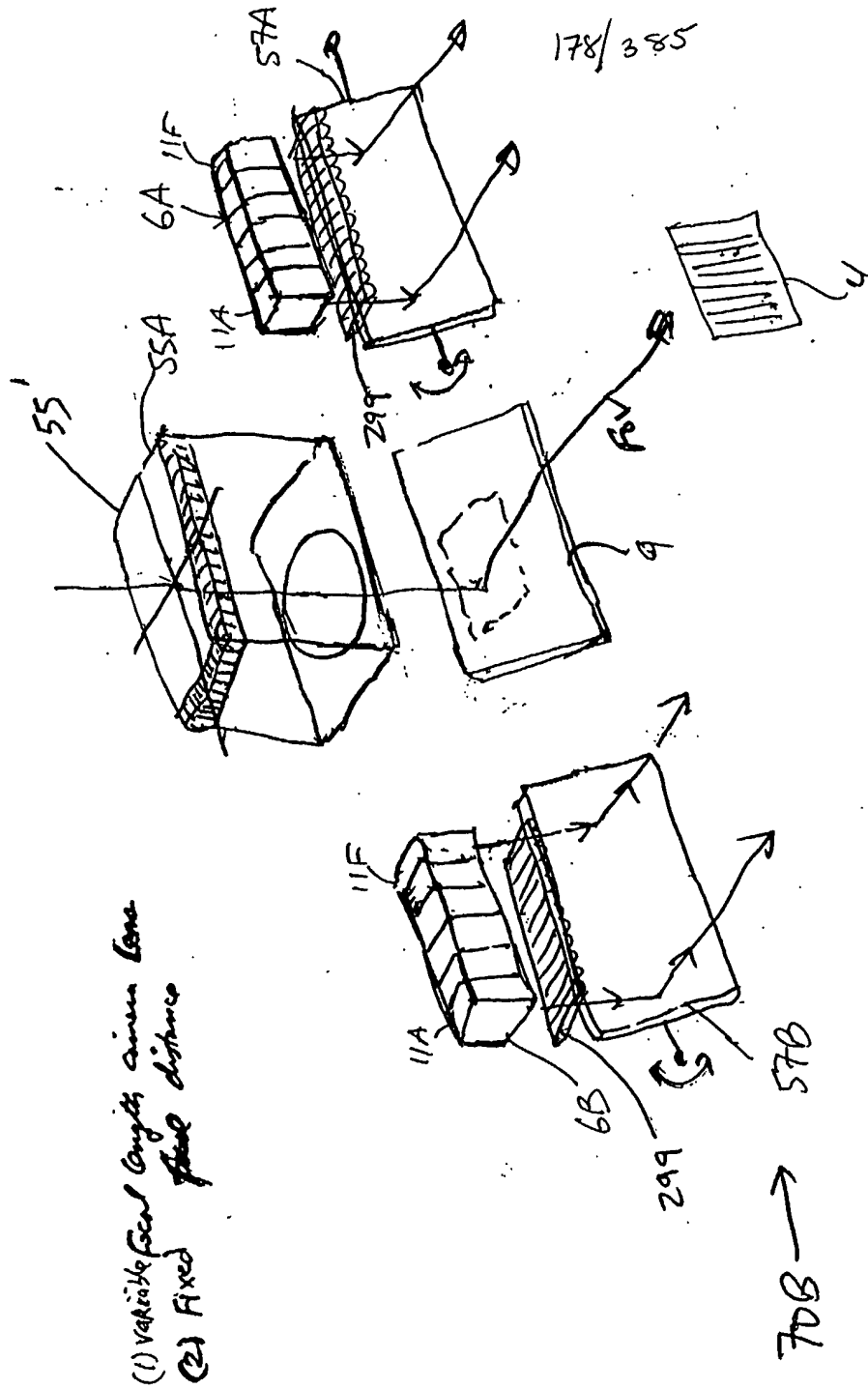


FIG. 5C

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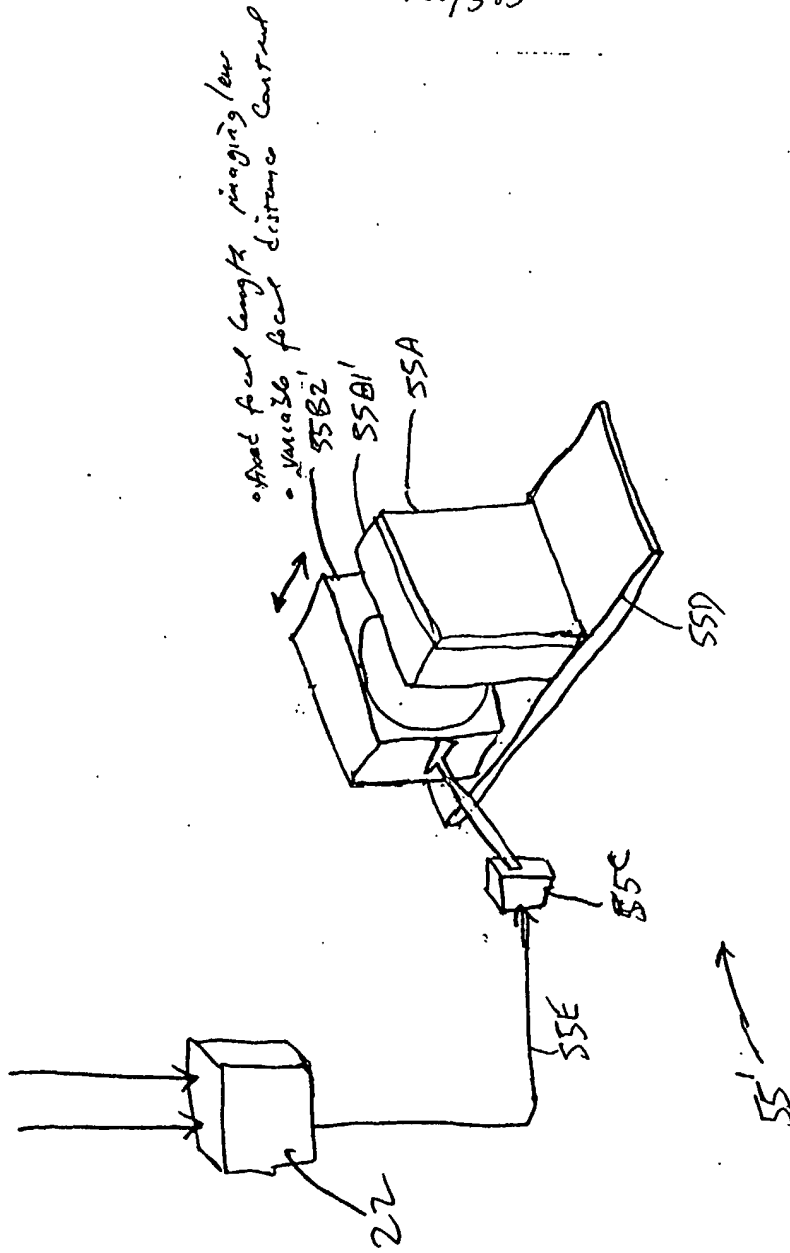


FIG. 5C4

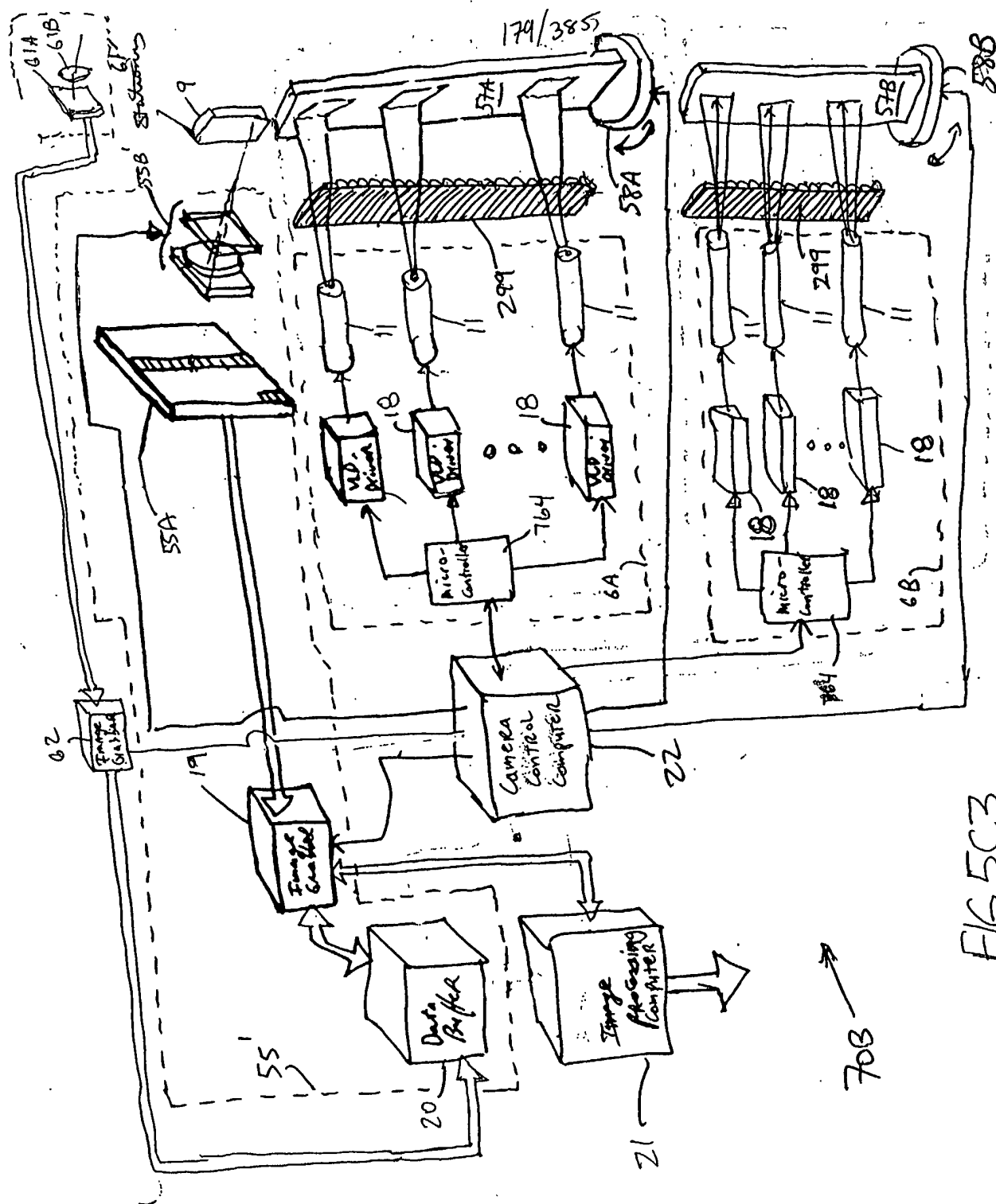


FIG. 5C3

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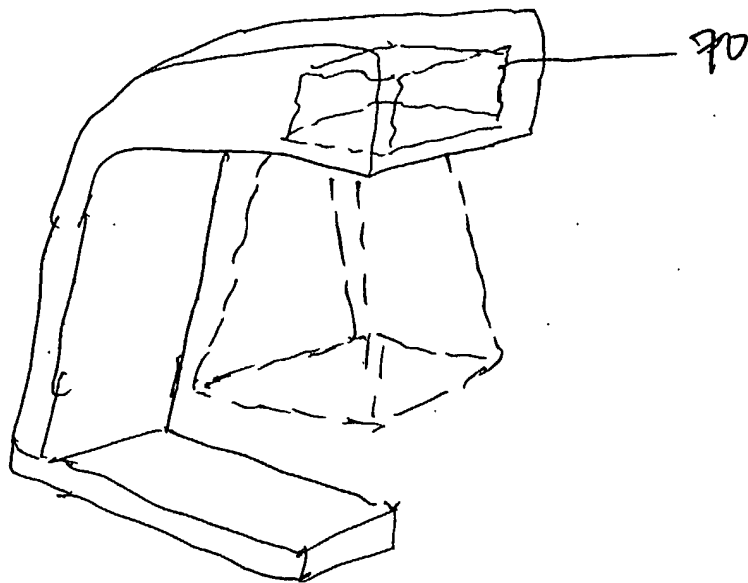


FIG. 5D

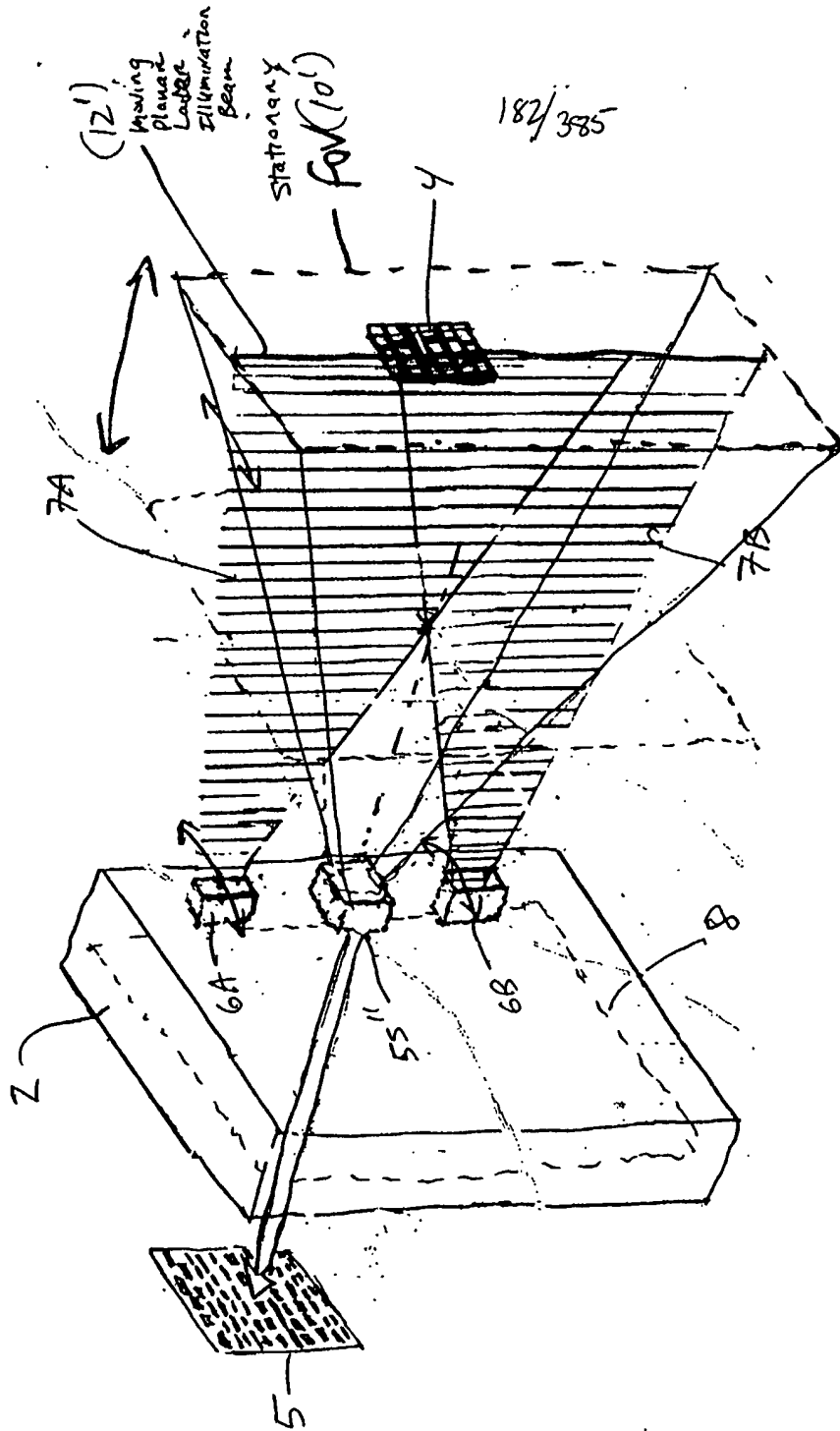


FIG. 6A

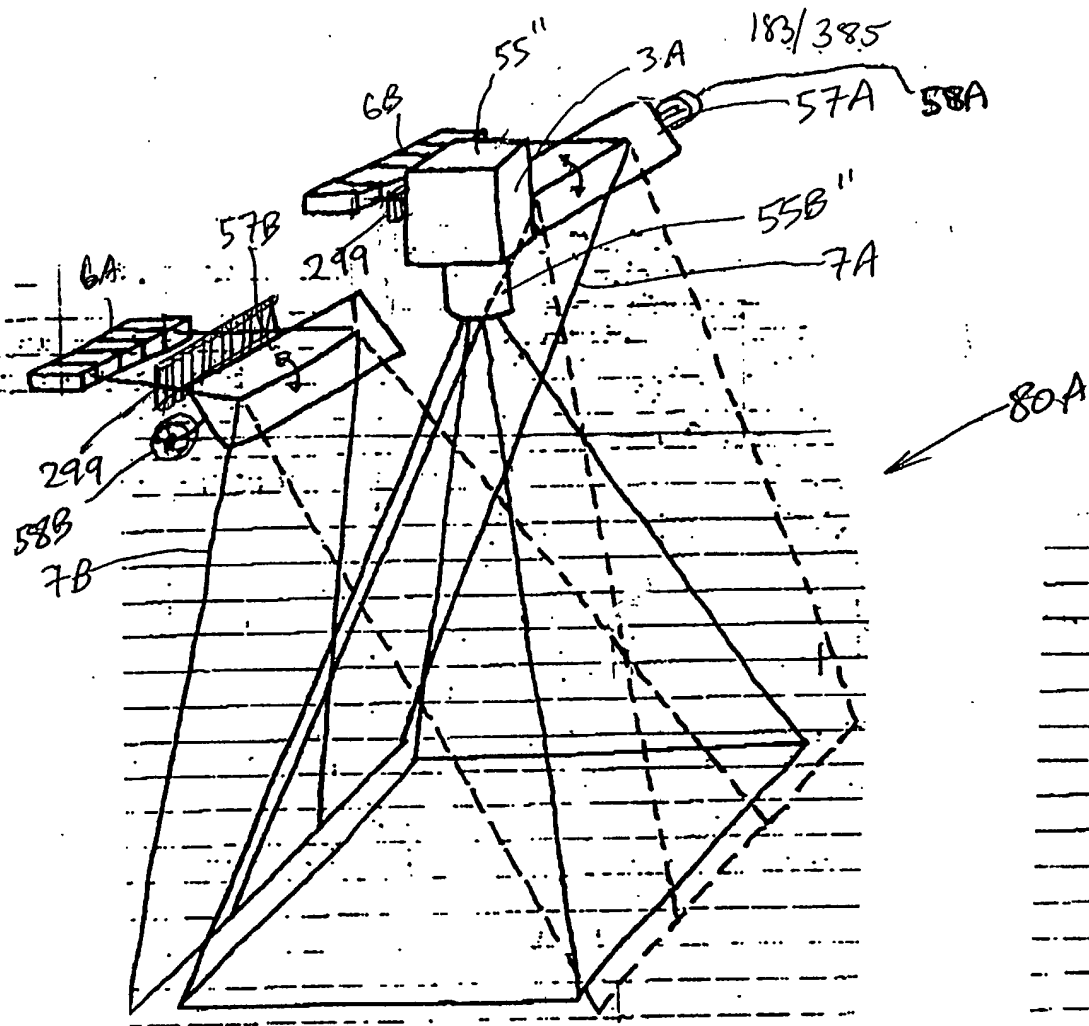
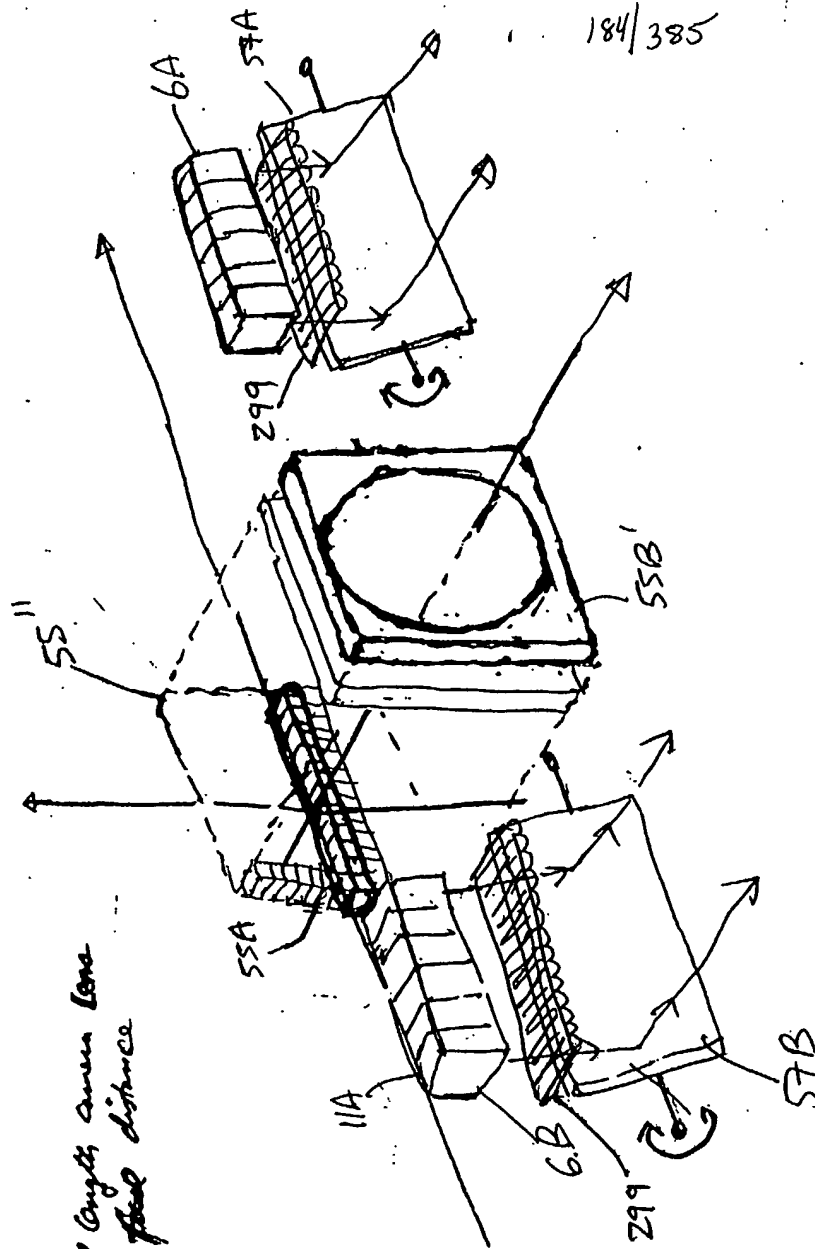


FIG. 6B1

$$184 \overline{) 385}$$


- (1) Δ is focal length, since lens
- (2) variable focal distance

(2) Variable fixed distance

30A

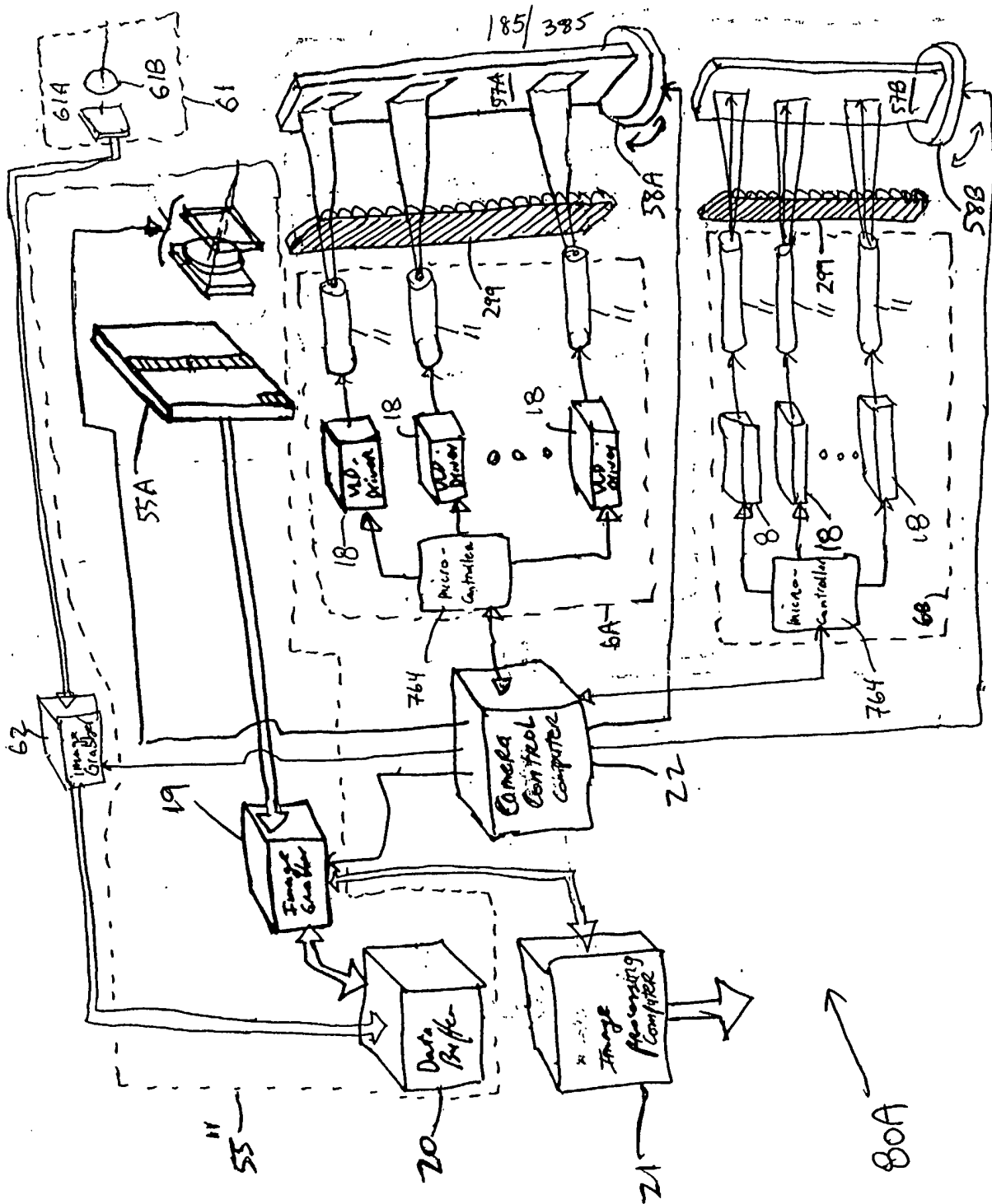


FIG. 6B3

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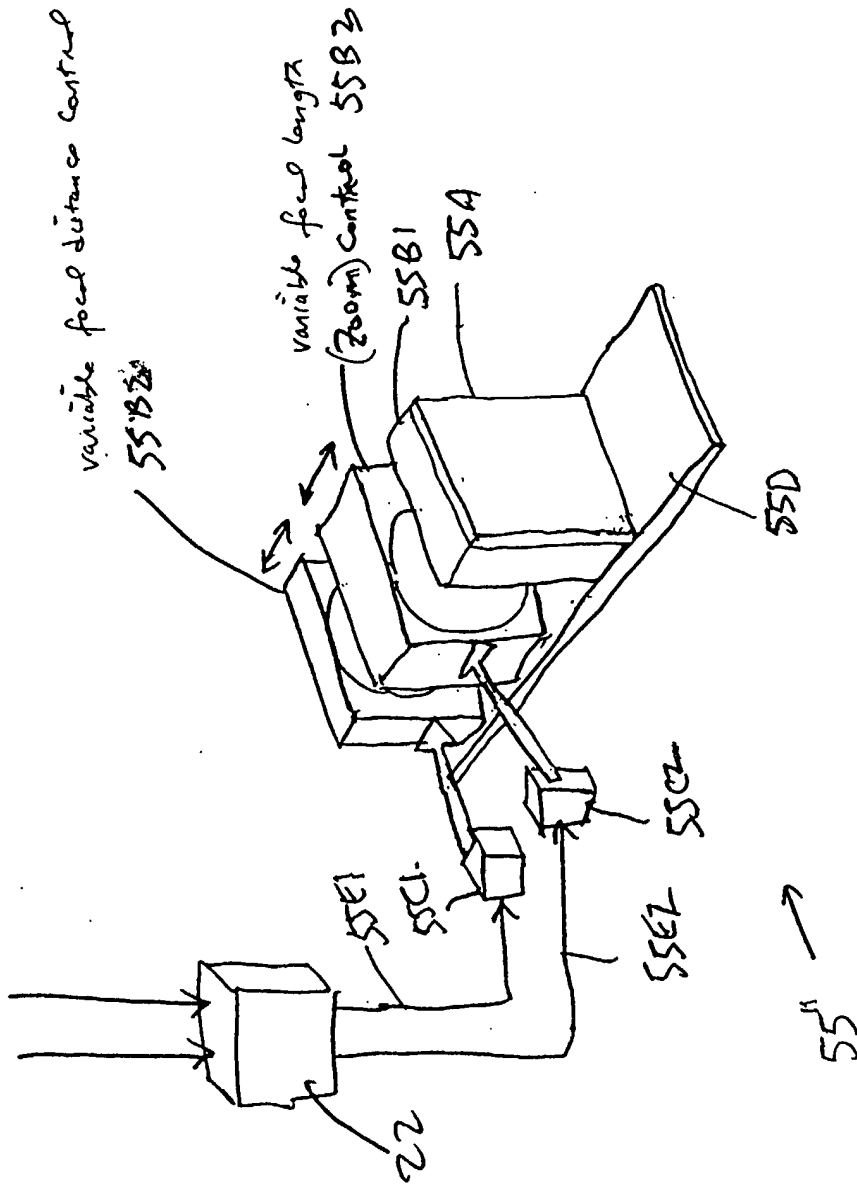


FIG. 6B4

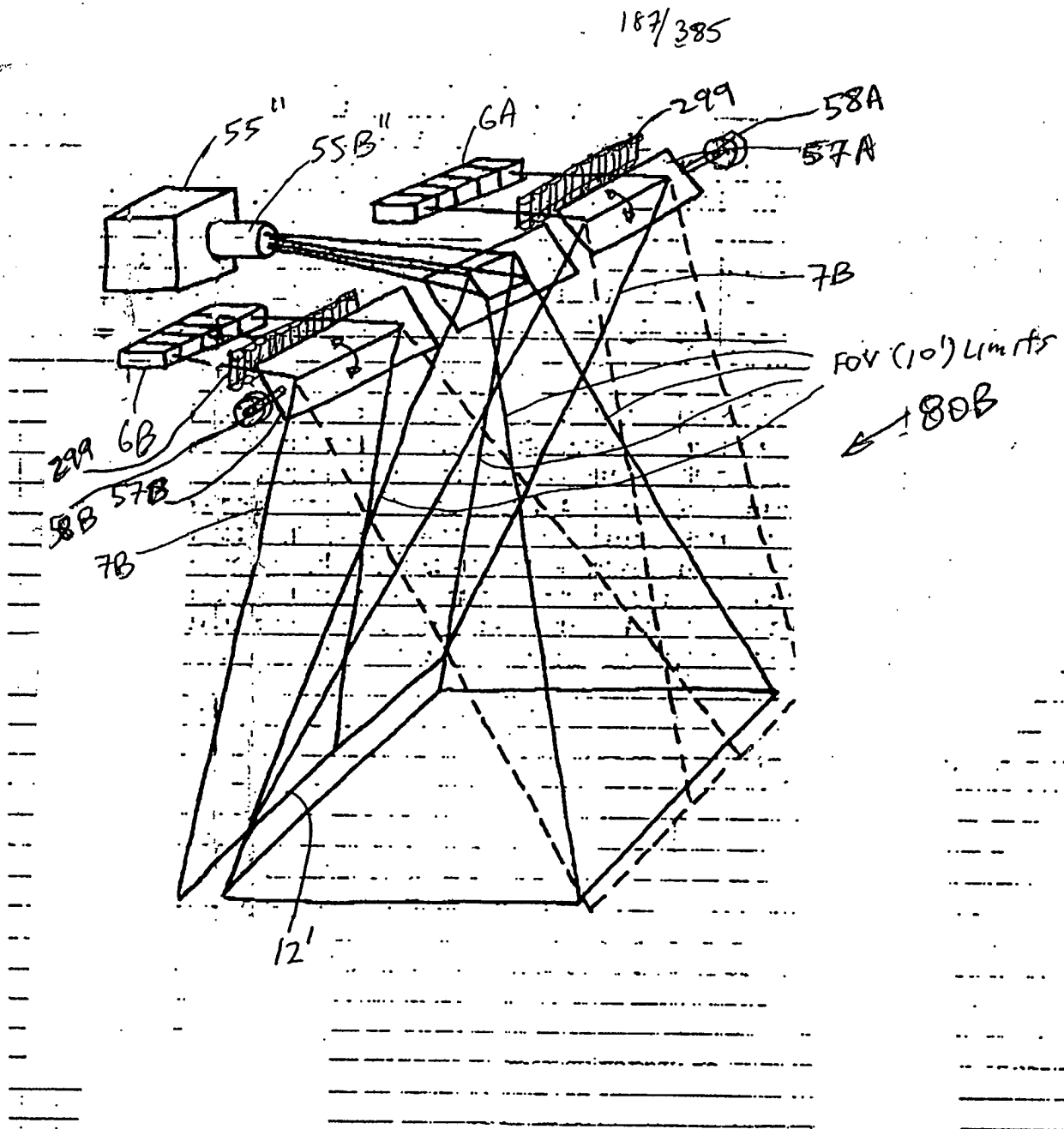


FIG. 6C1

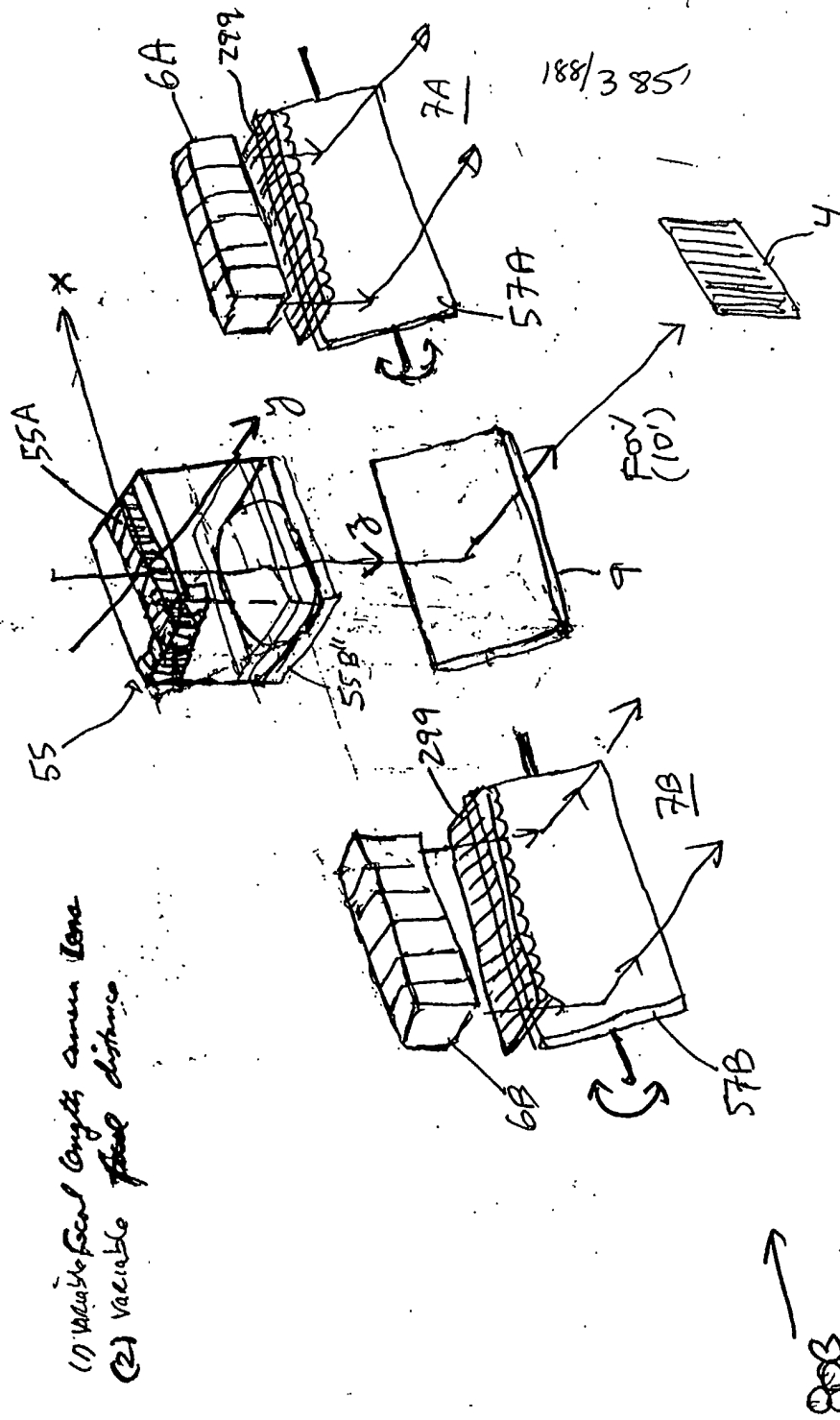


FIG. 6C2

(1) variable length, inner lens
(2) variable focal distance

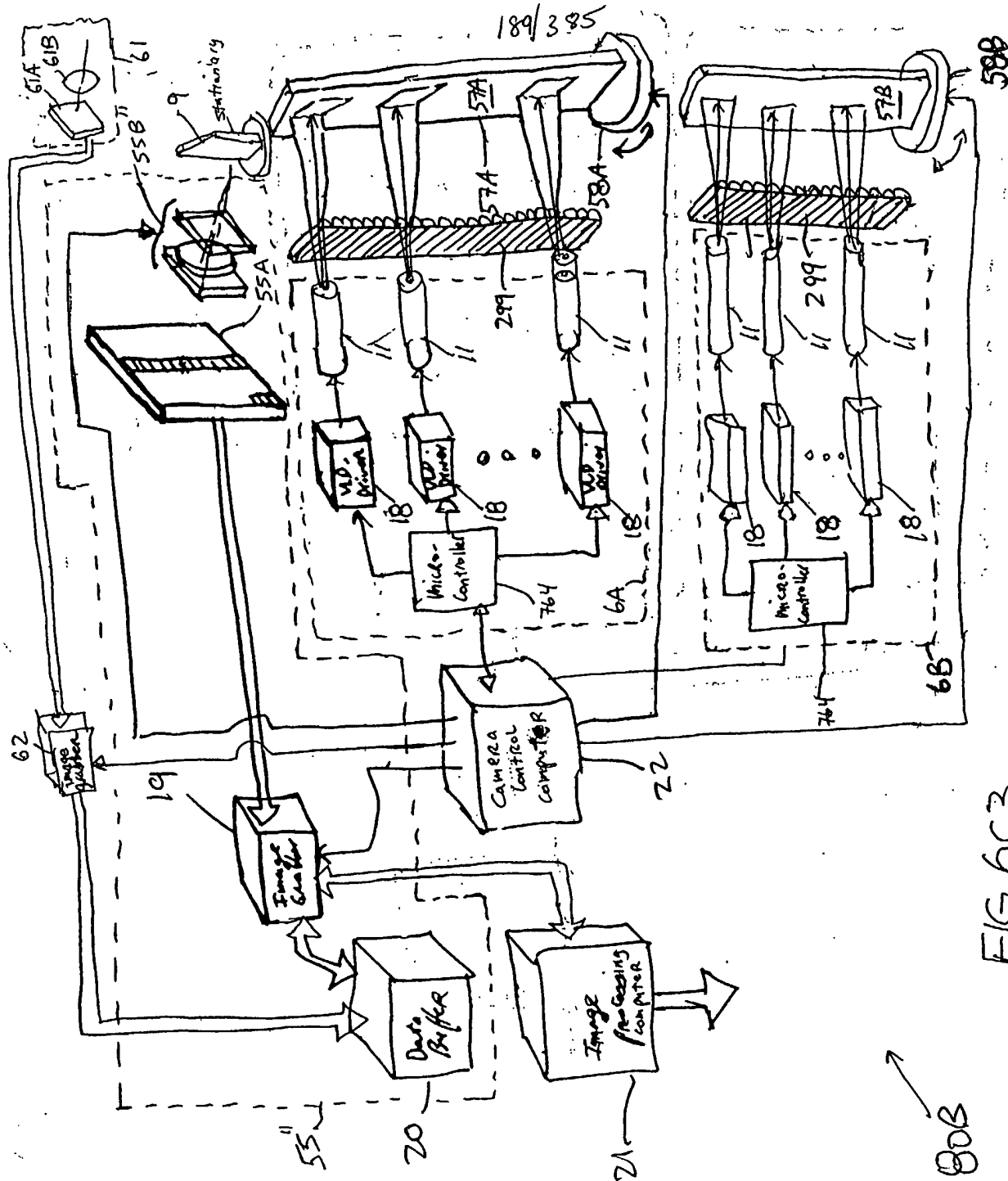
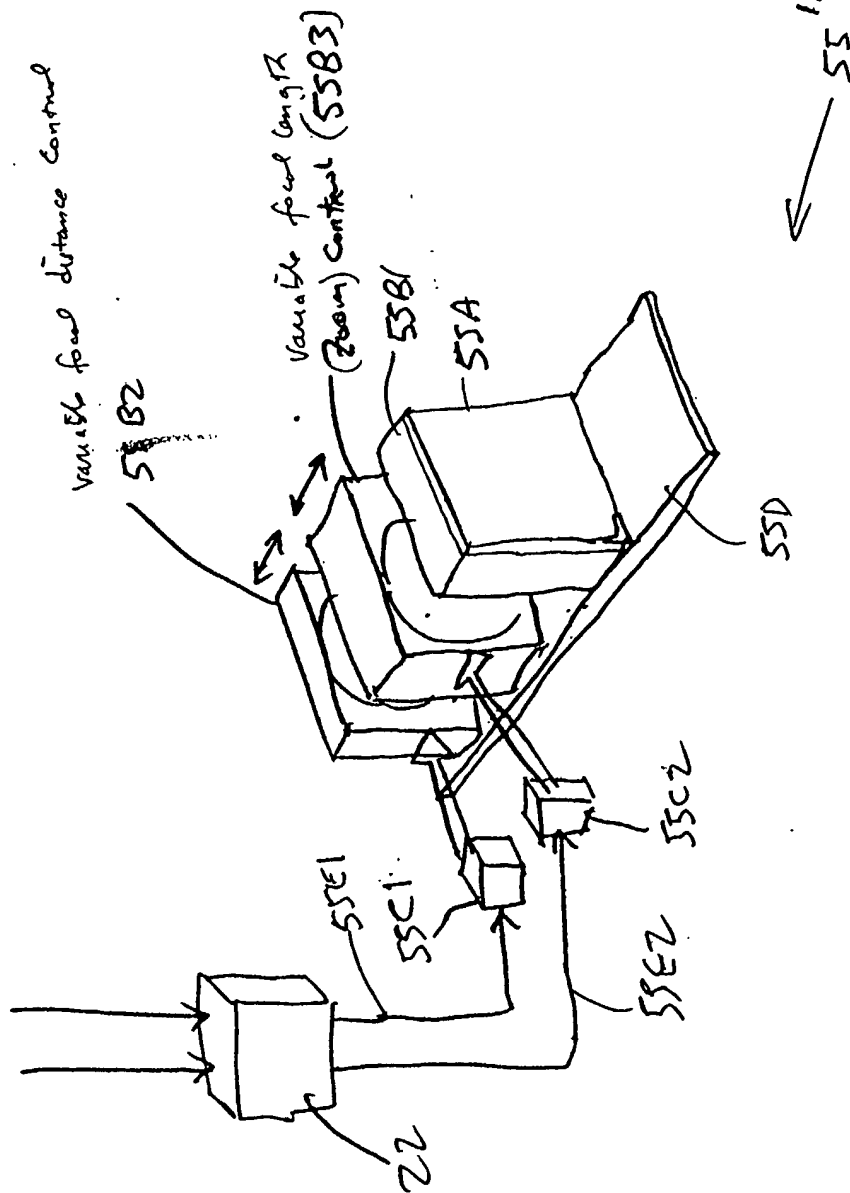


FIG. 6C3

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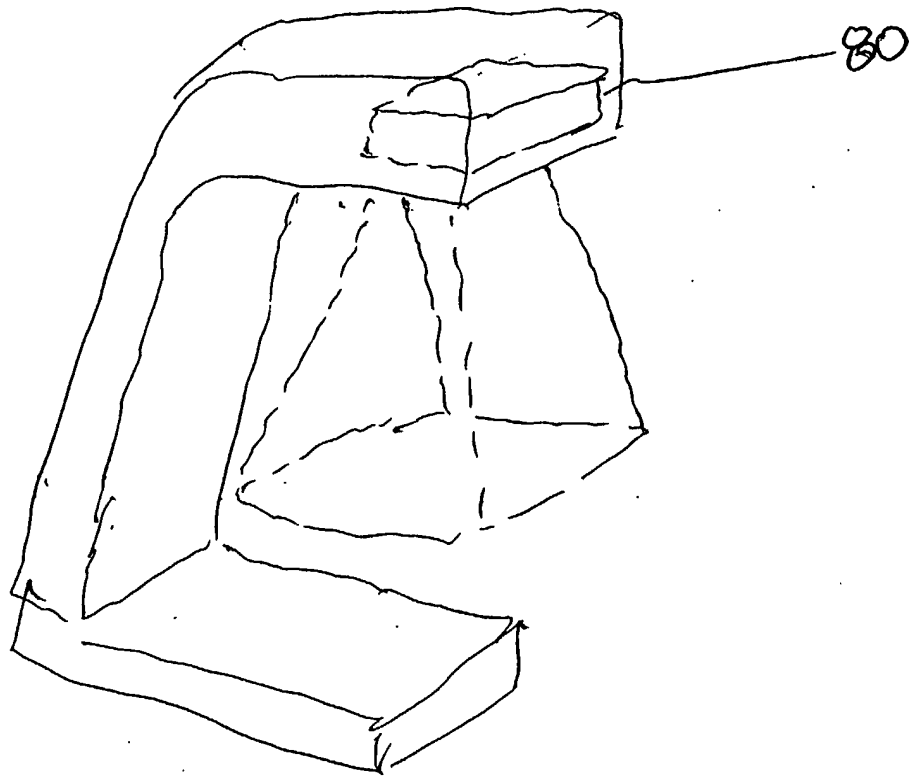
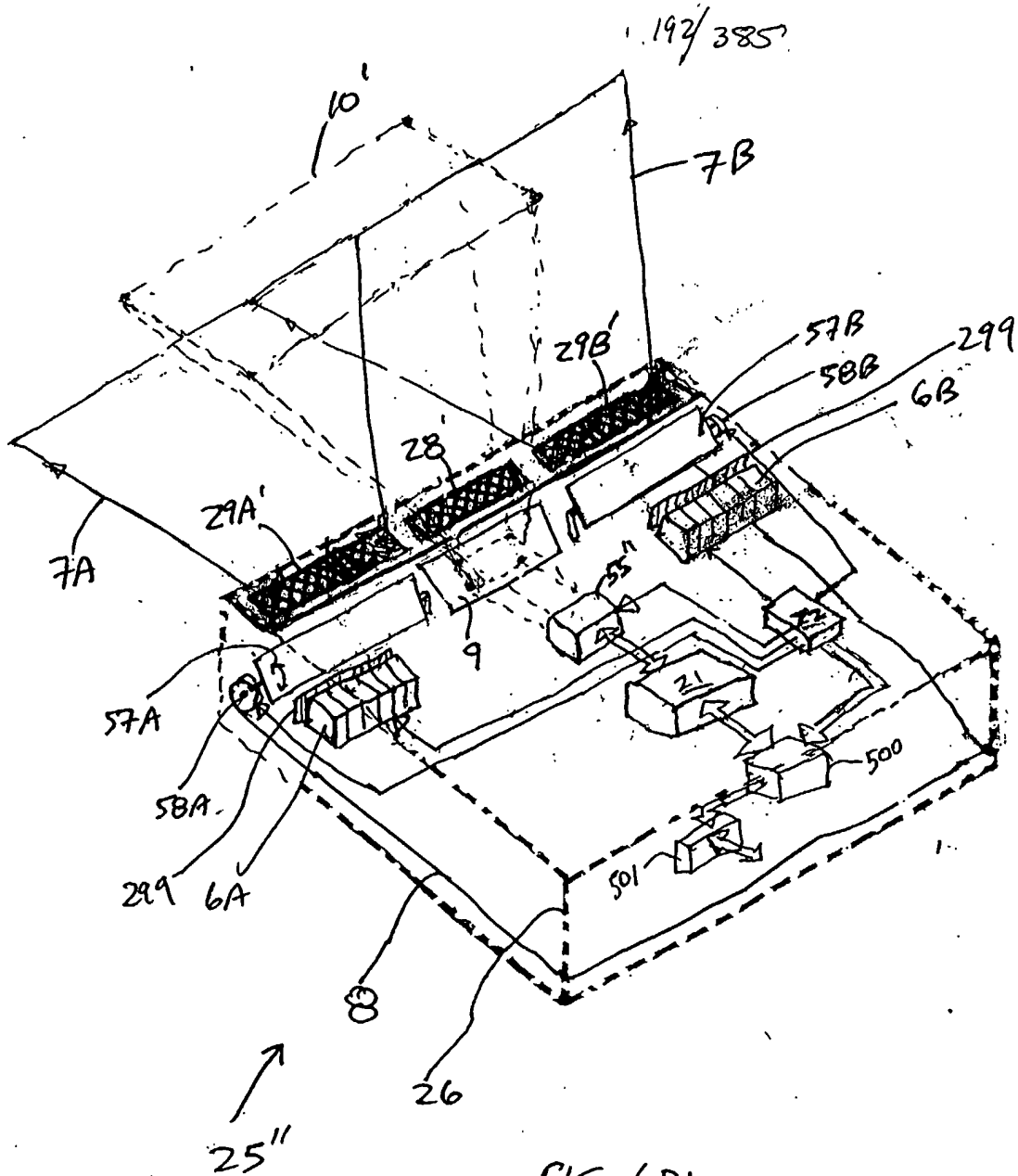


FIG. 6C5



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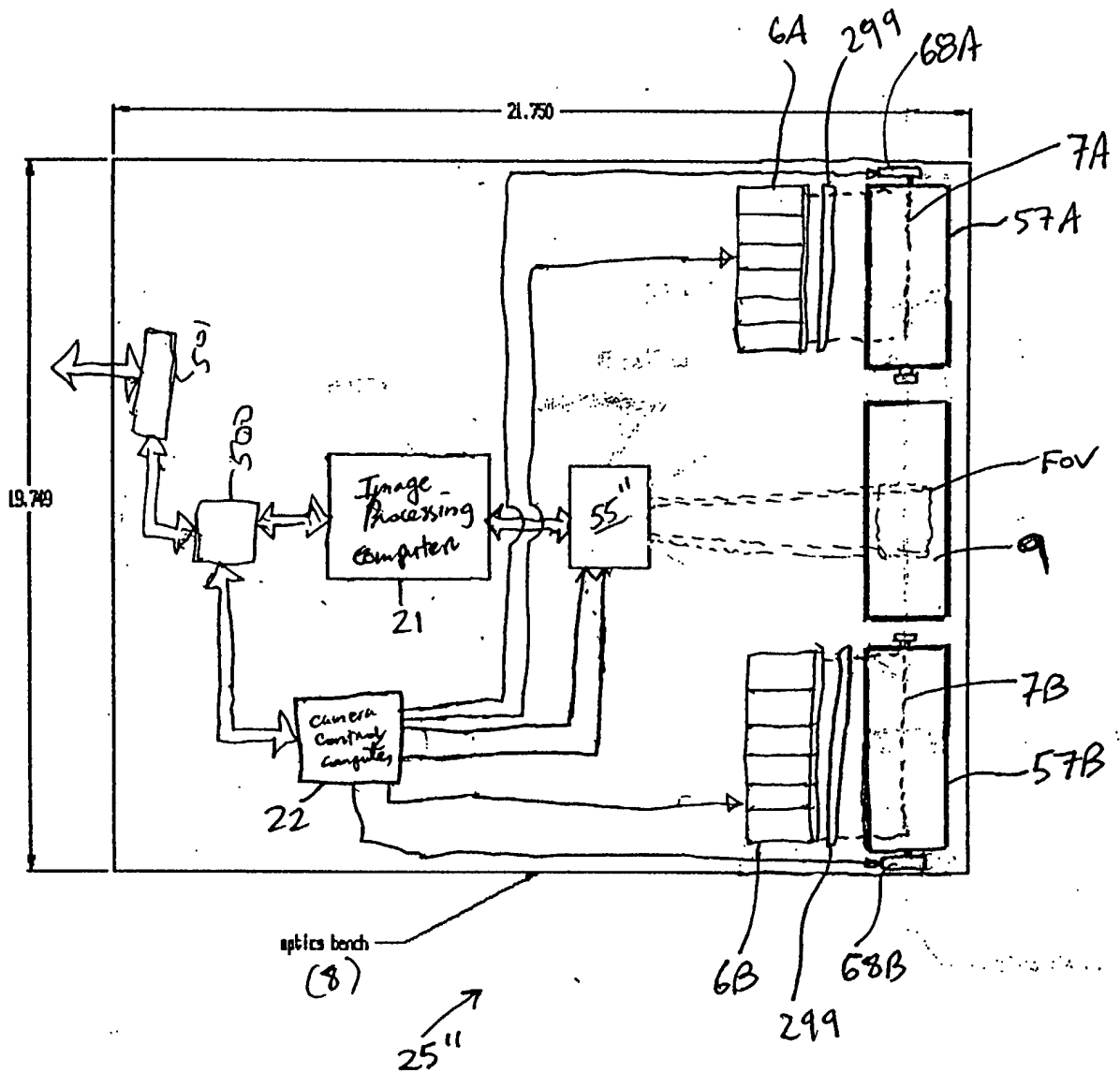
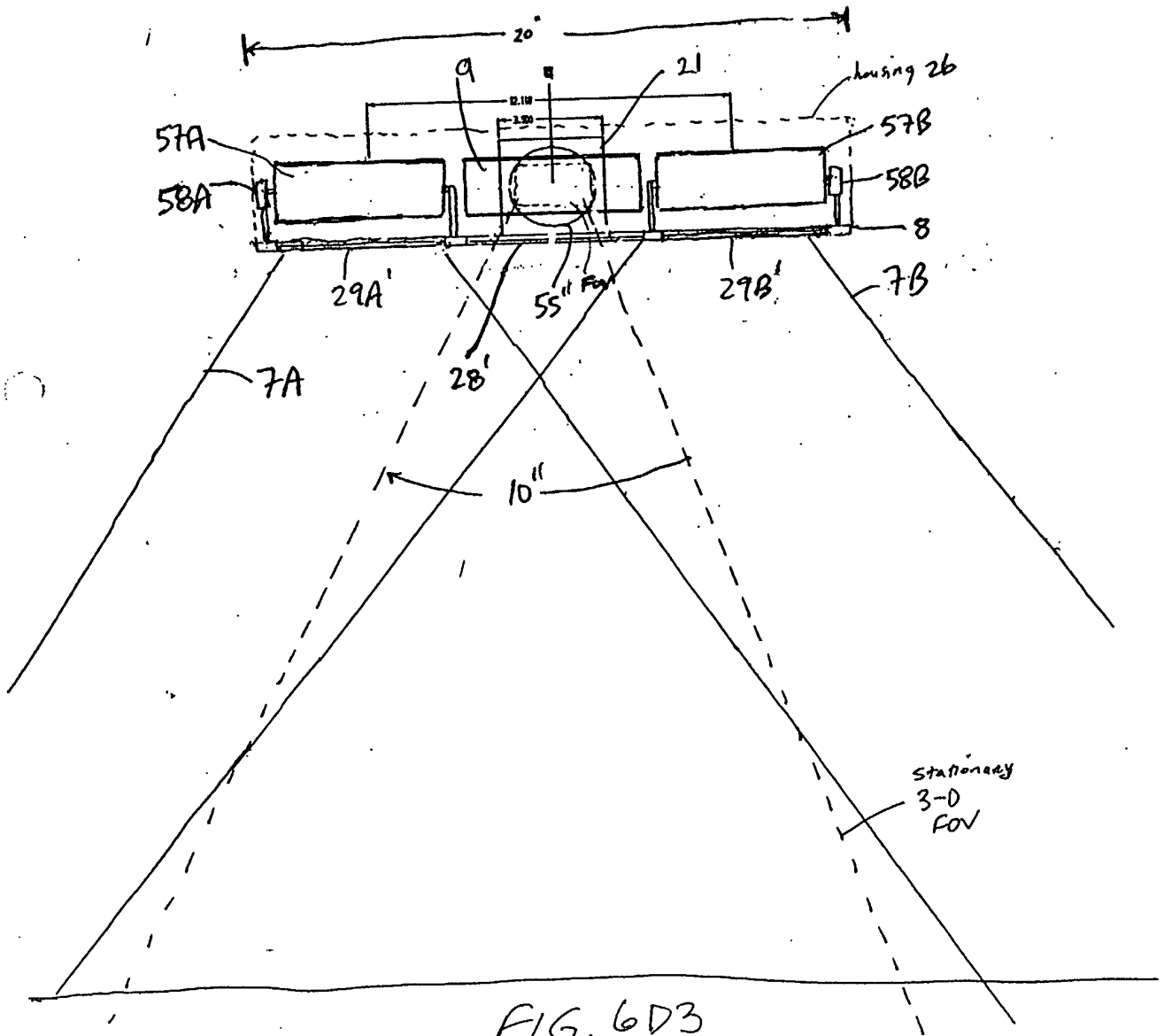


FIG. 6DZ

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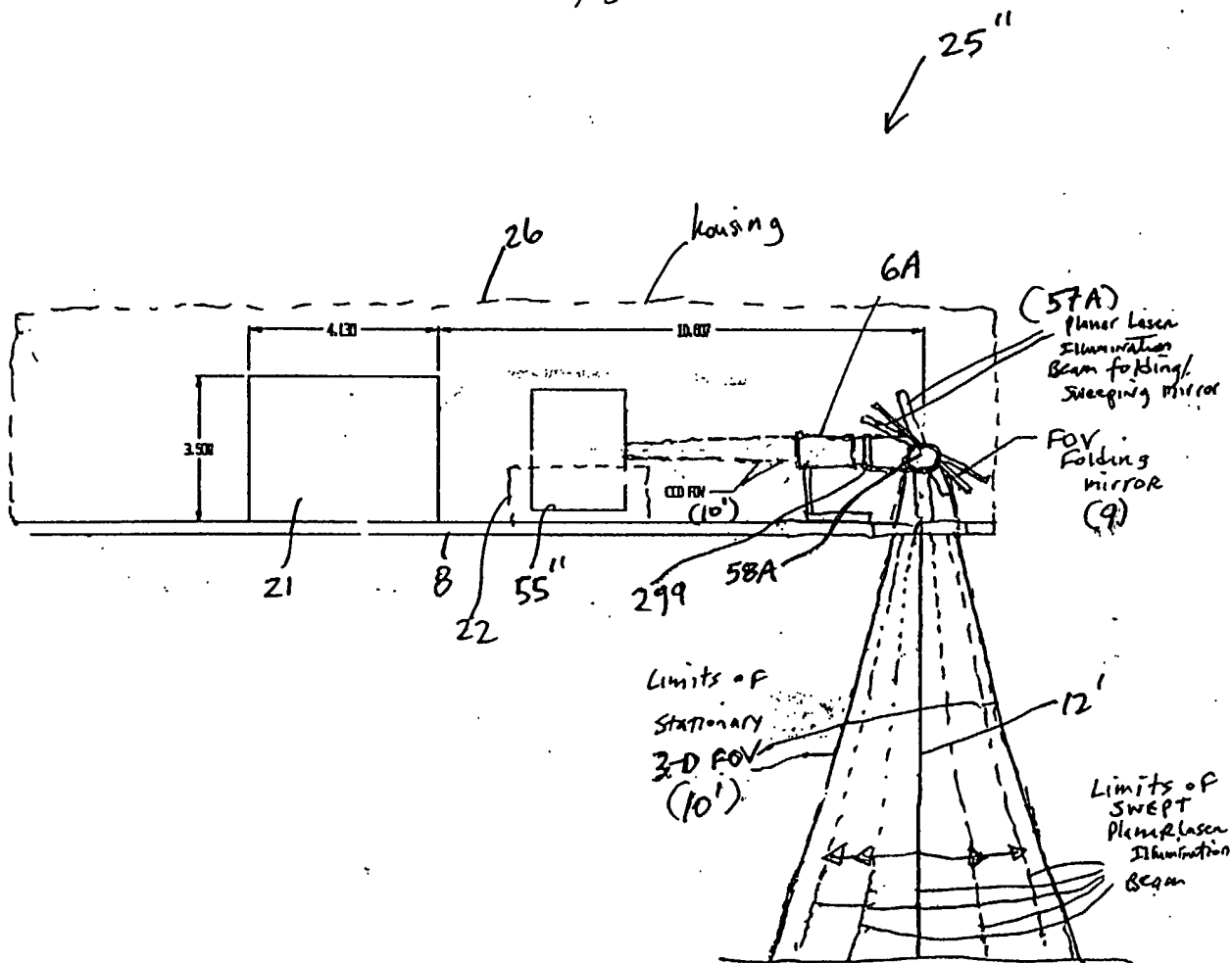


FIG. 6D4

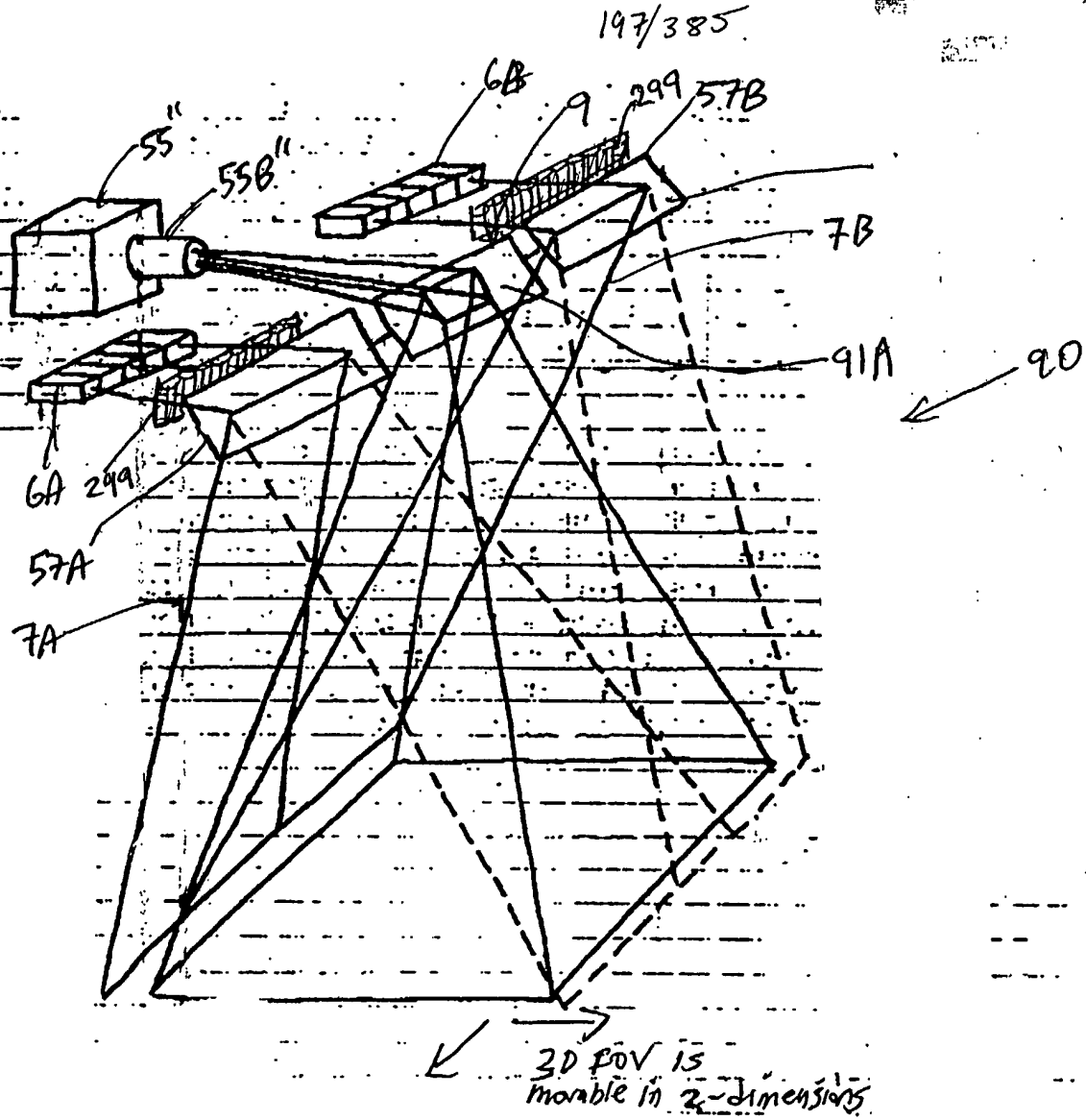
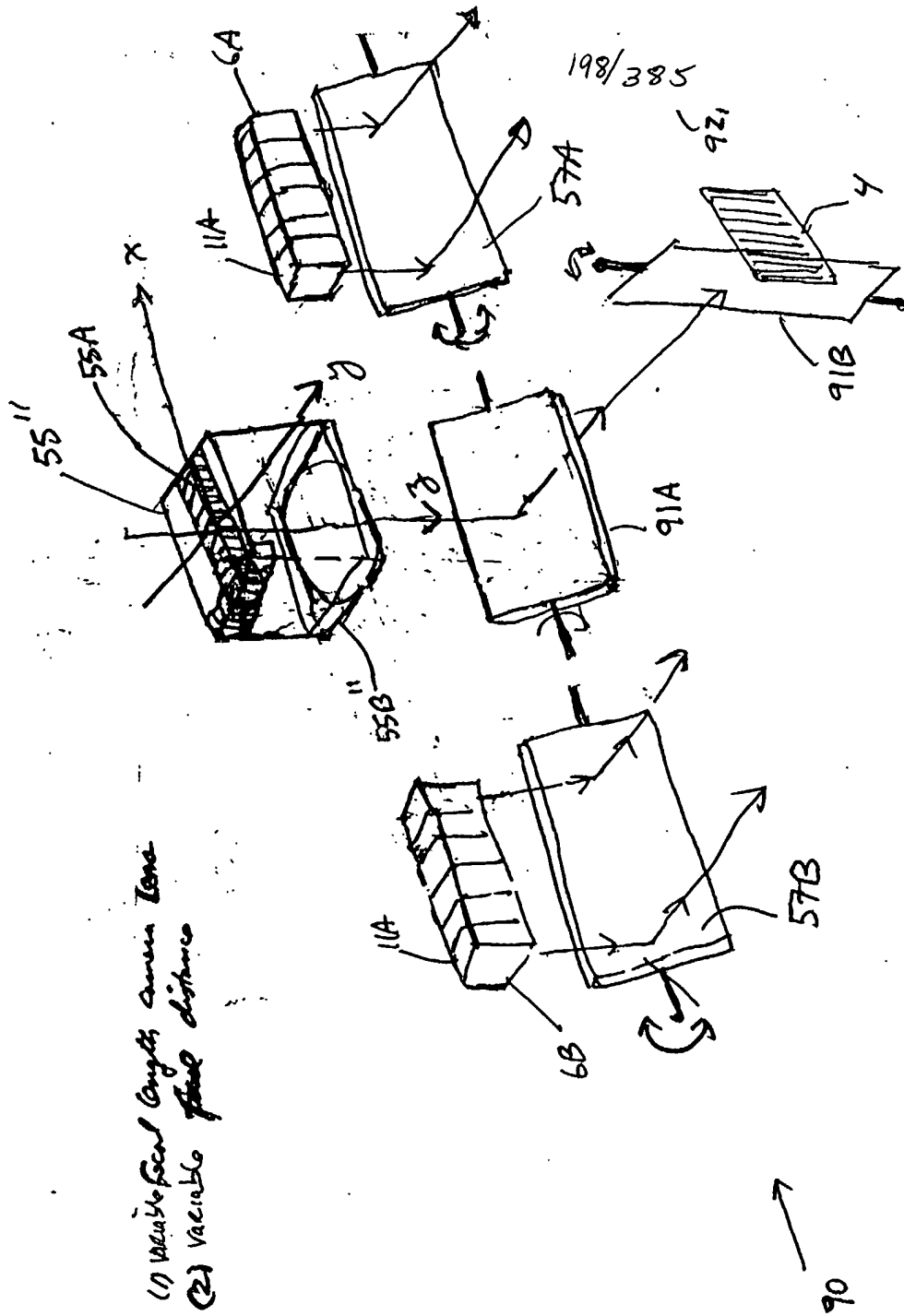


FIG. 6E1



(1) Variable length array sensor tone
(2) Variable fluid distance

FIG. 6E2

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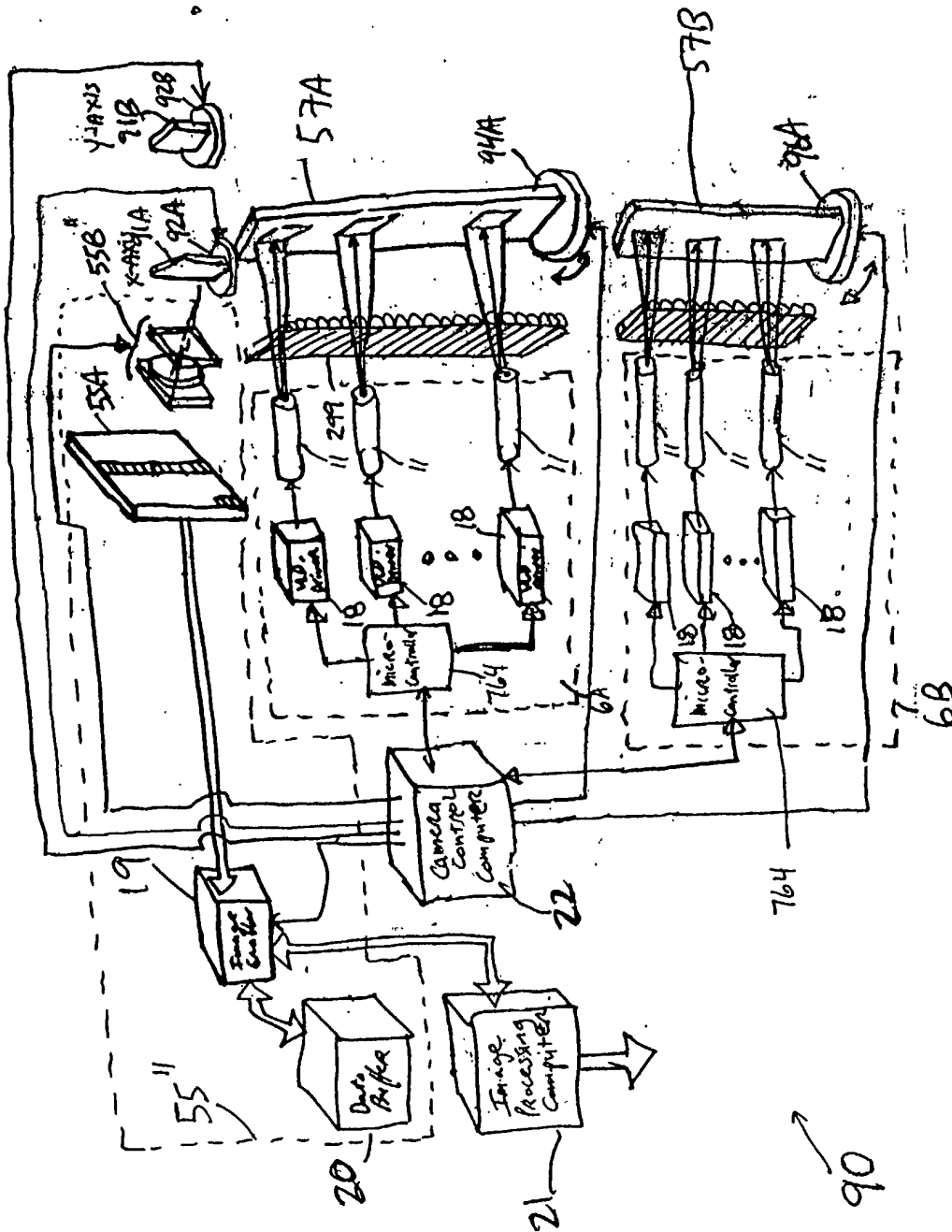


FIG. 6E3

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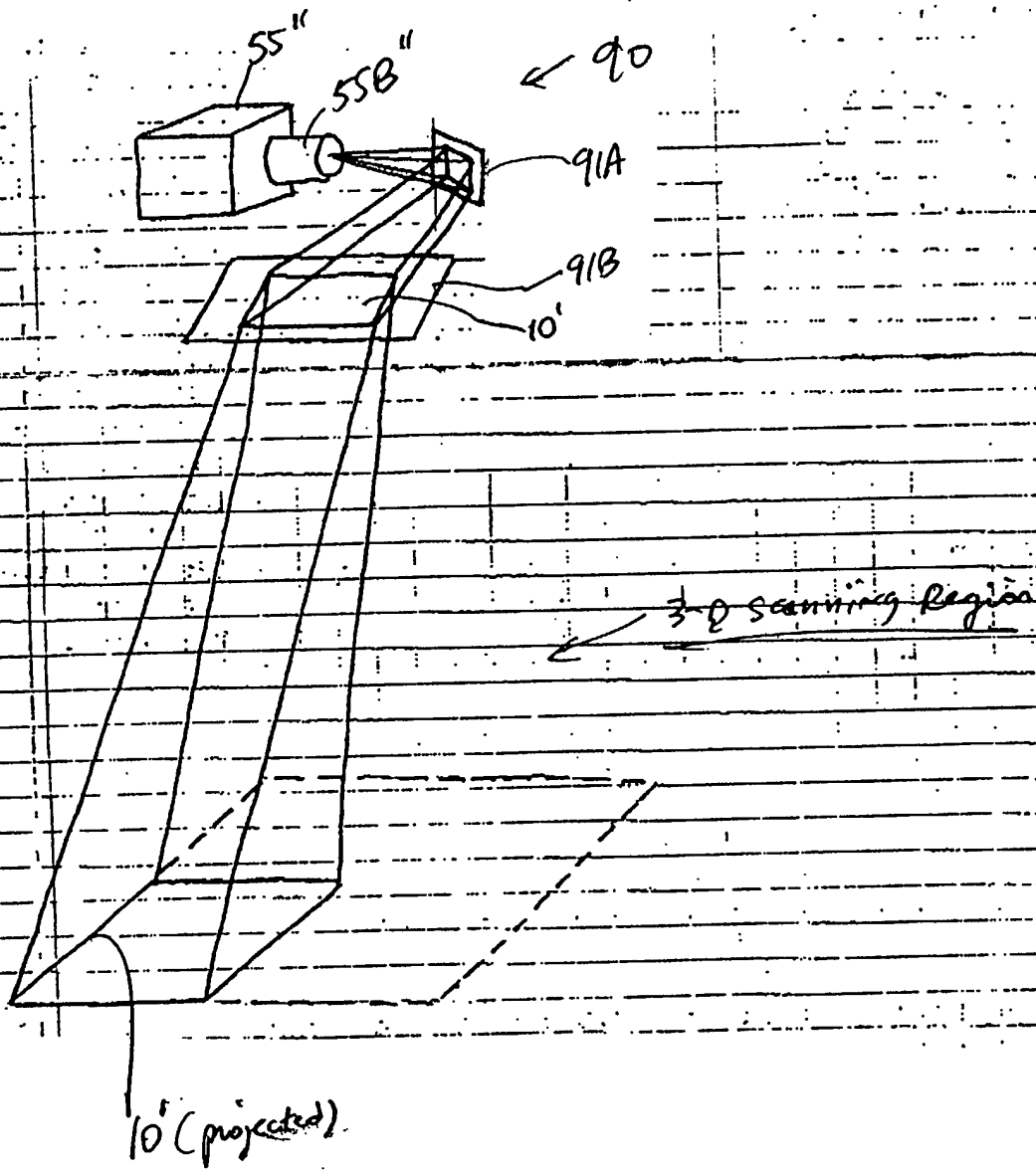
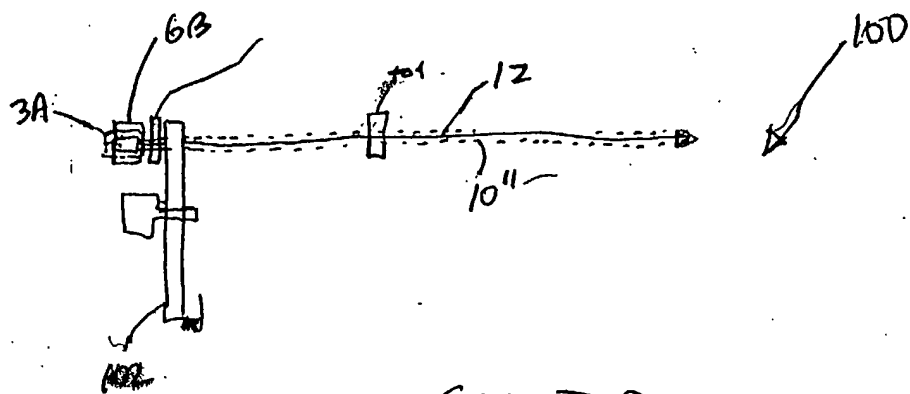
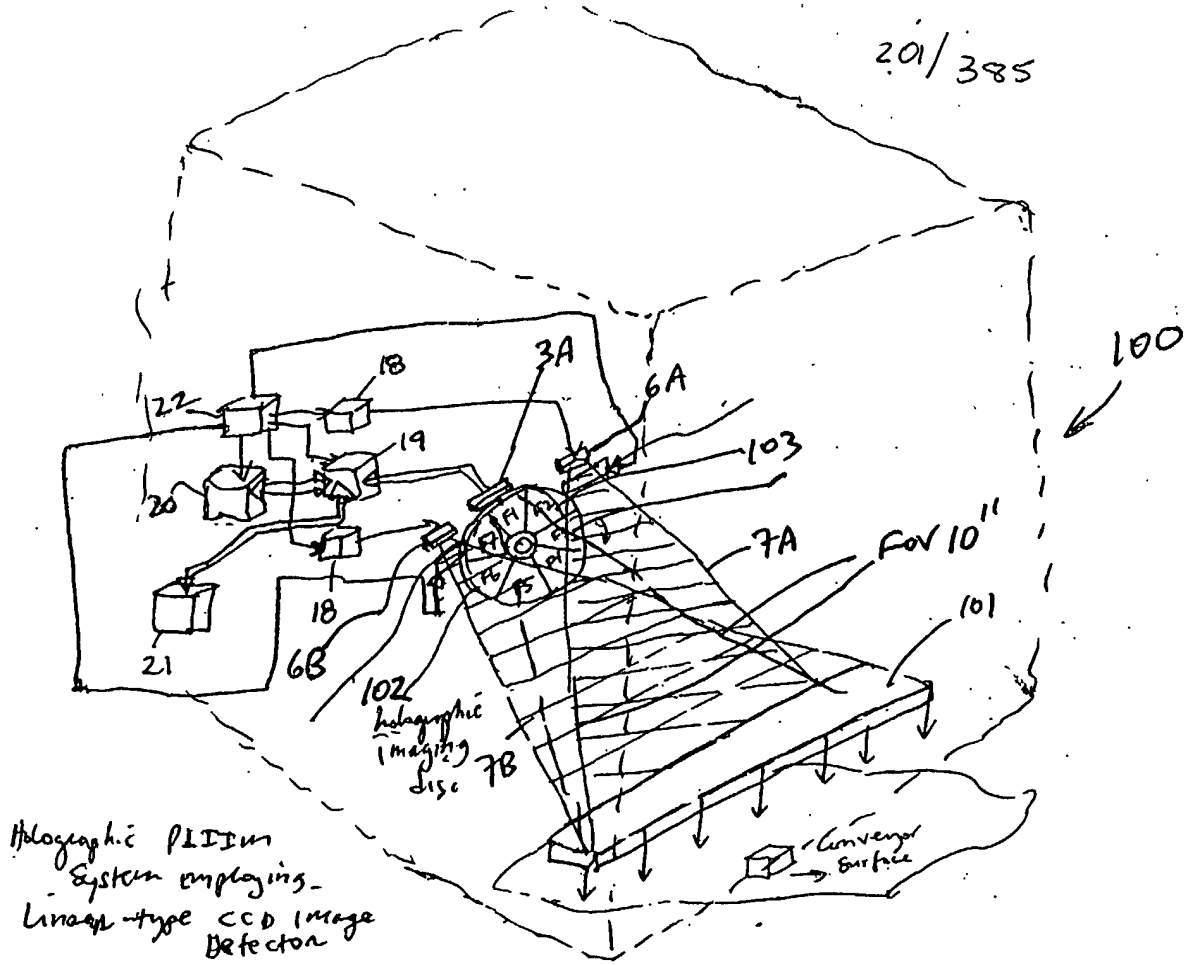


FIG. 6E4



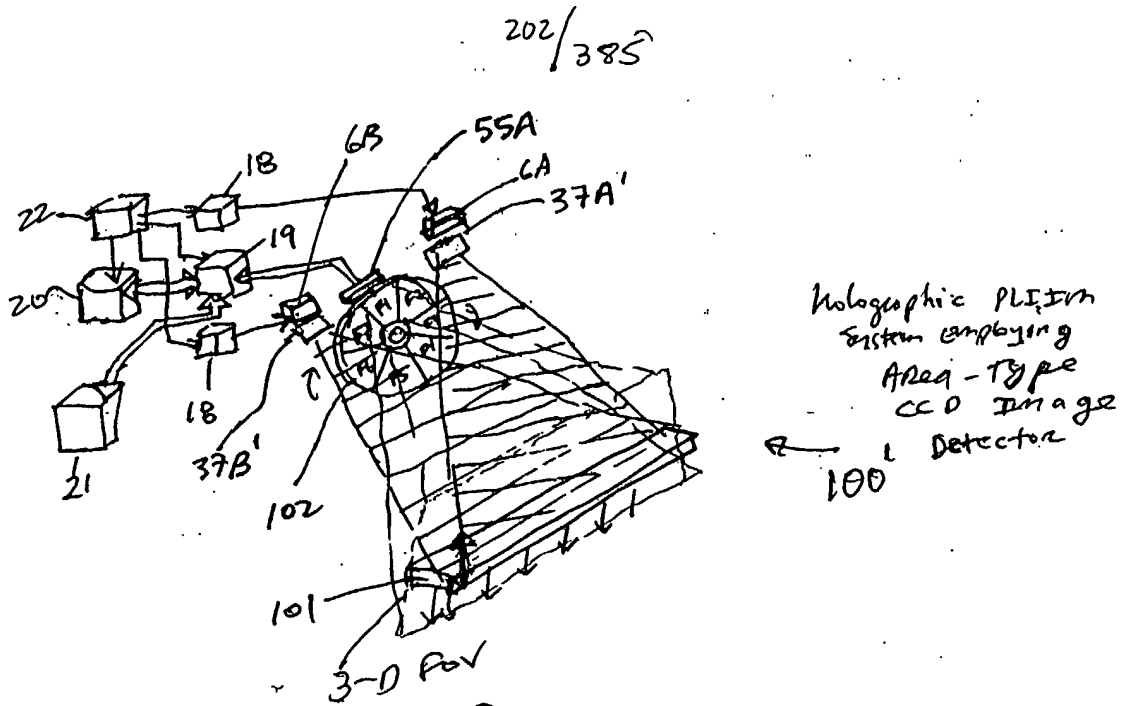


FIG. 8A

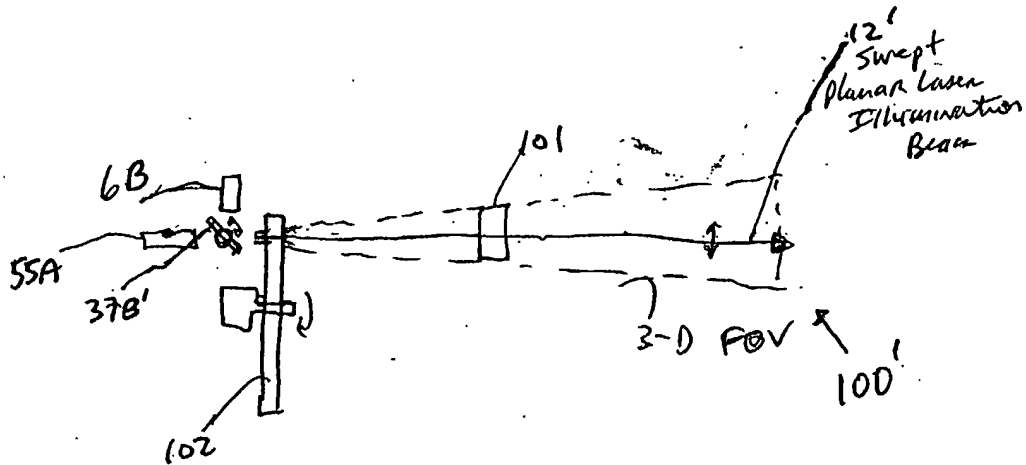


FIG. 8B

$$203 \overline{) 385}$$

1-D CCD SCANNER EMBODIMENT

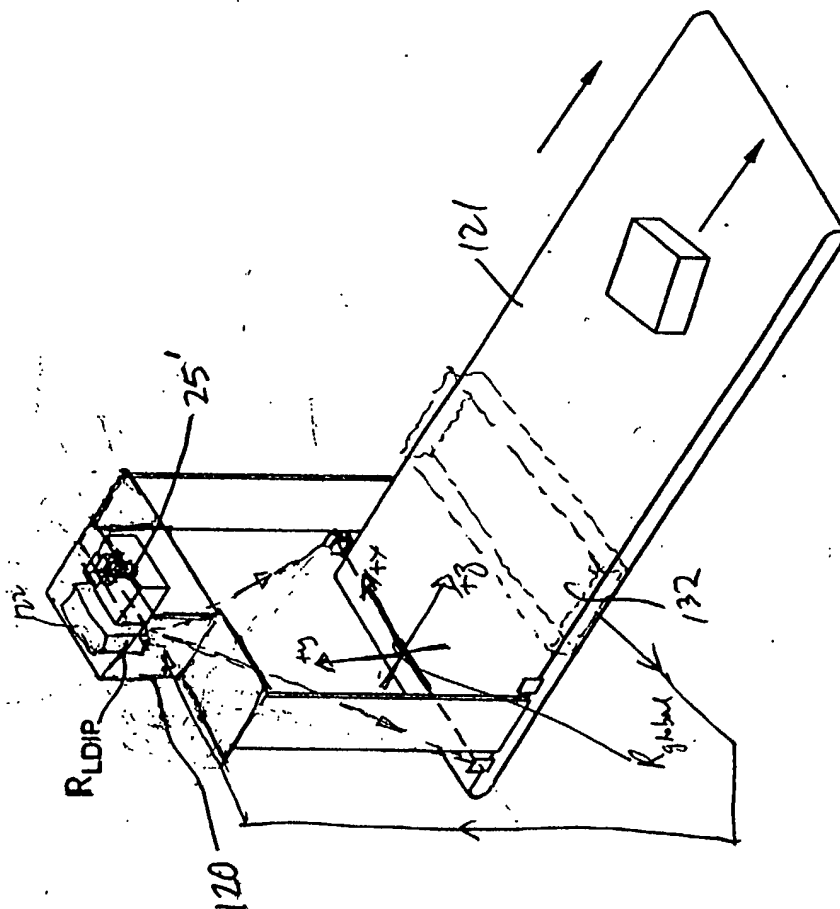


FIG. 9

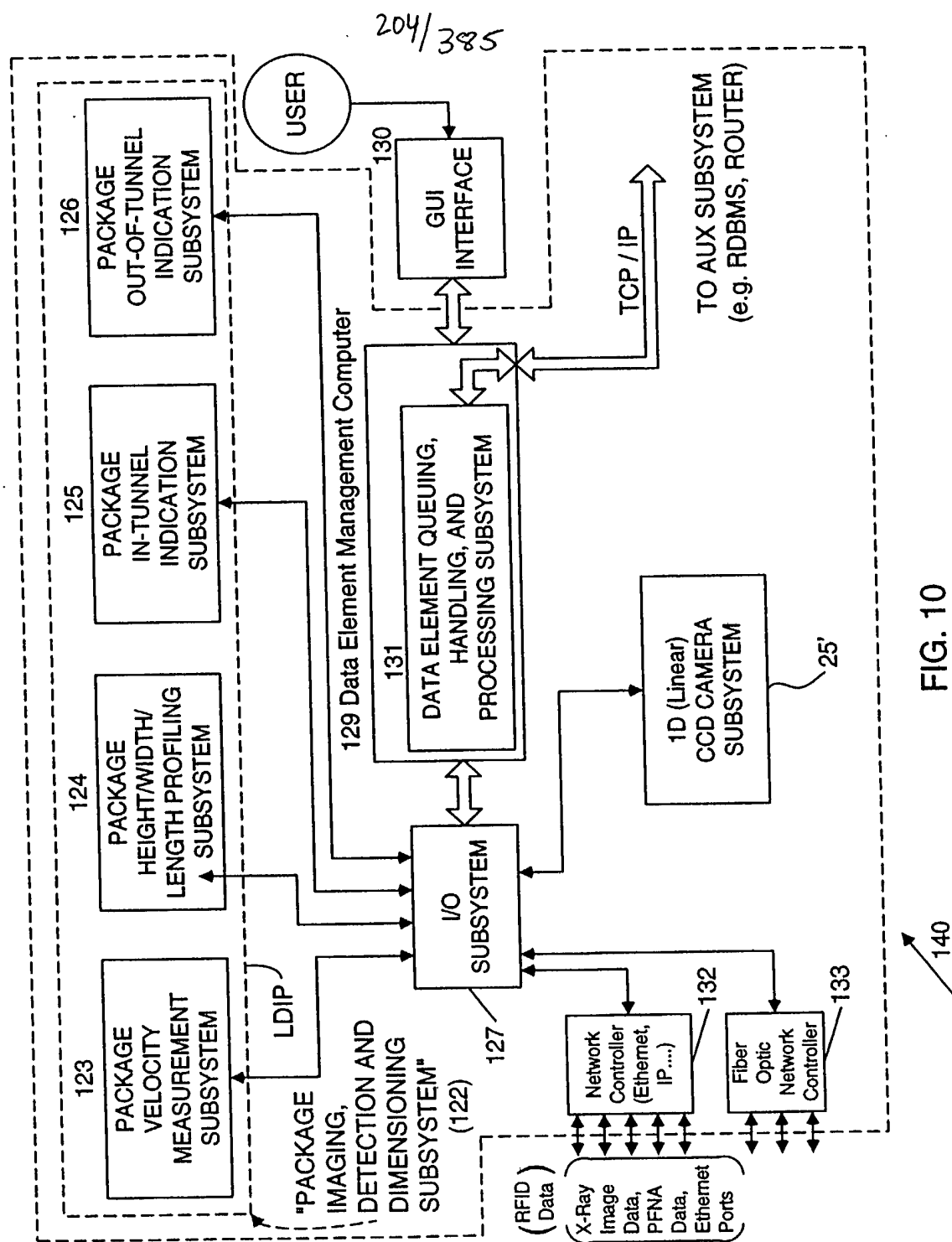


FIG. 10

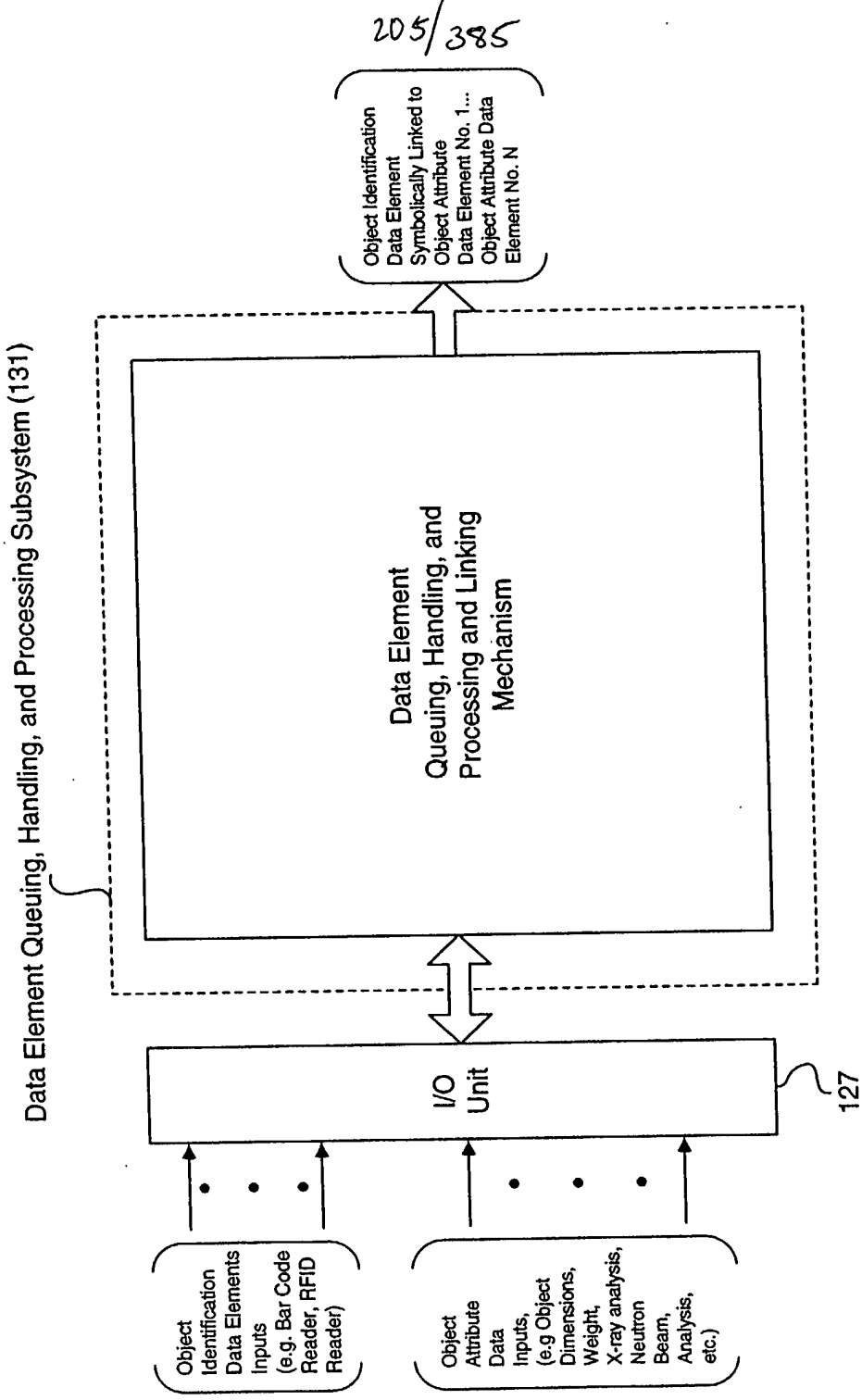


FIG. 10A

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Primary Network
and/or System
Functions:

A.
Specification of Object
Detection and
Tracking Capability of
System

B.
Specification of Object
Identification
Capability of System

C.
Specification of
Object Attribute
Acquisition Capability
of System

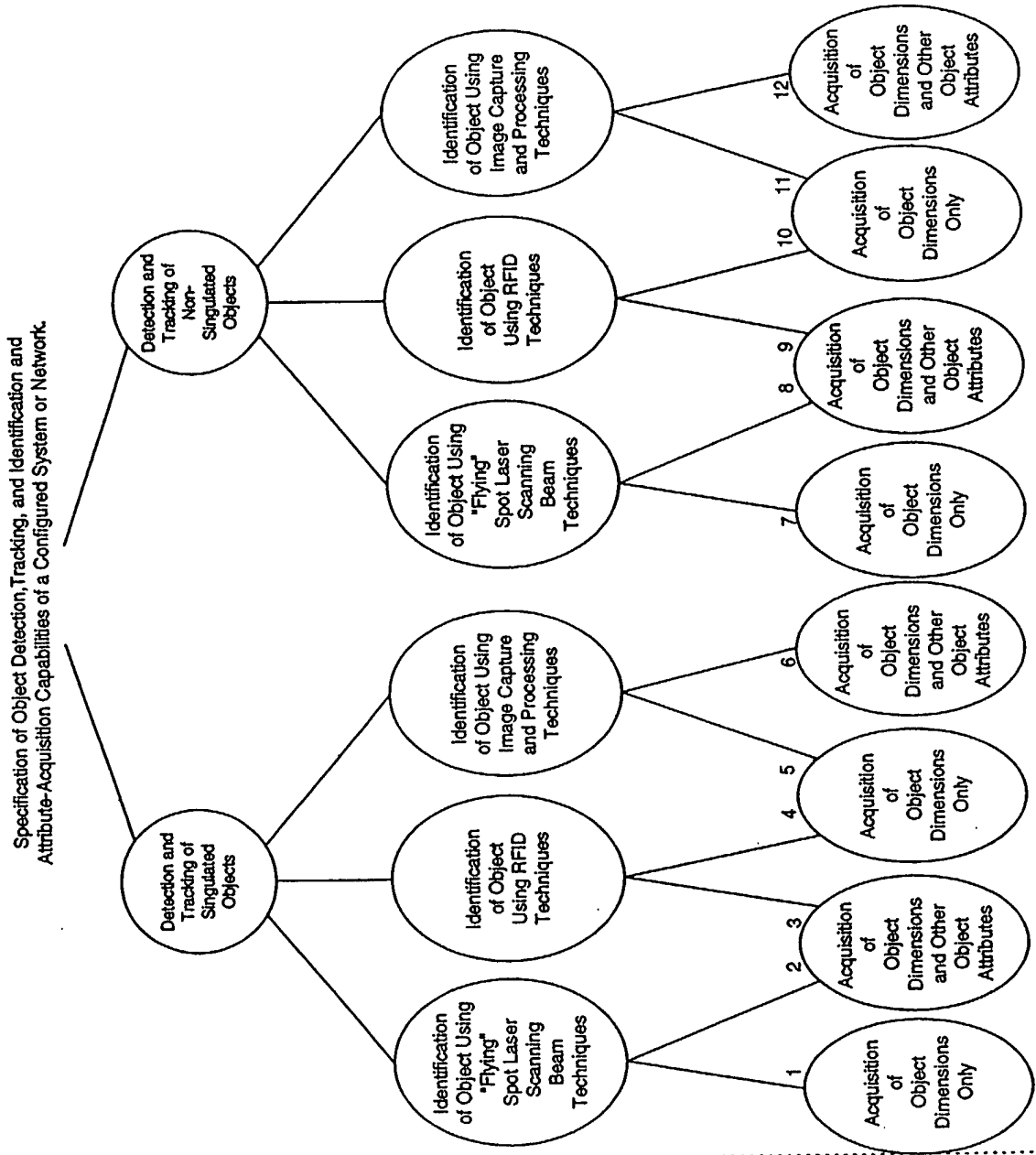


FIG. 10B

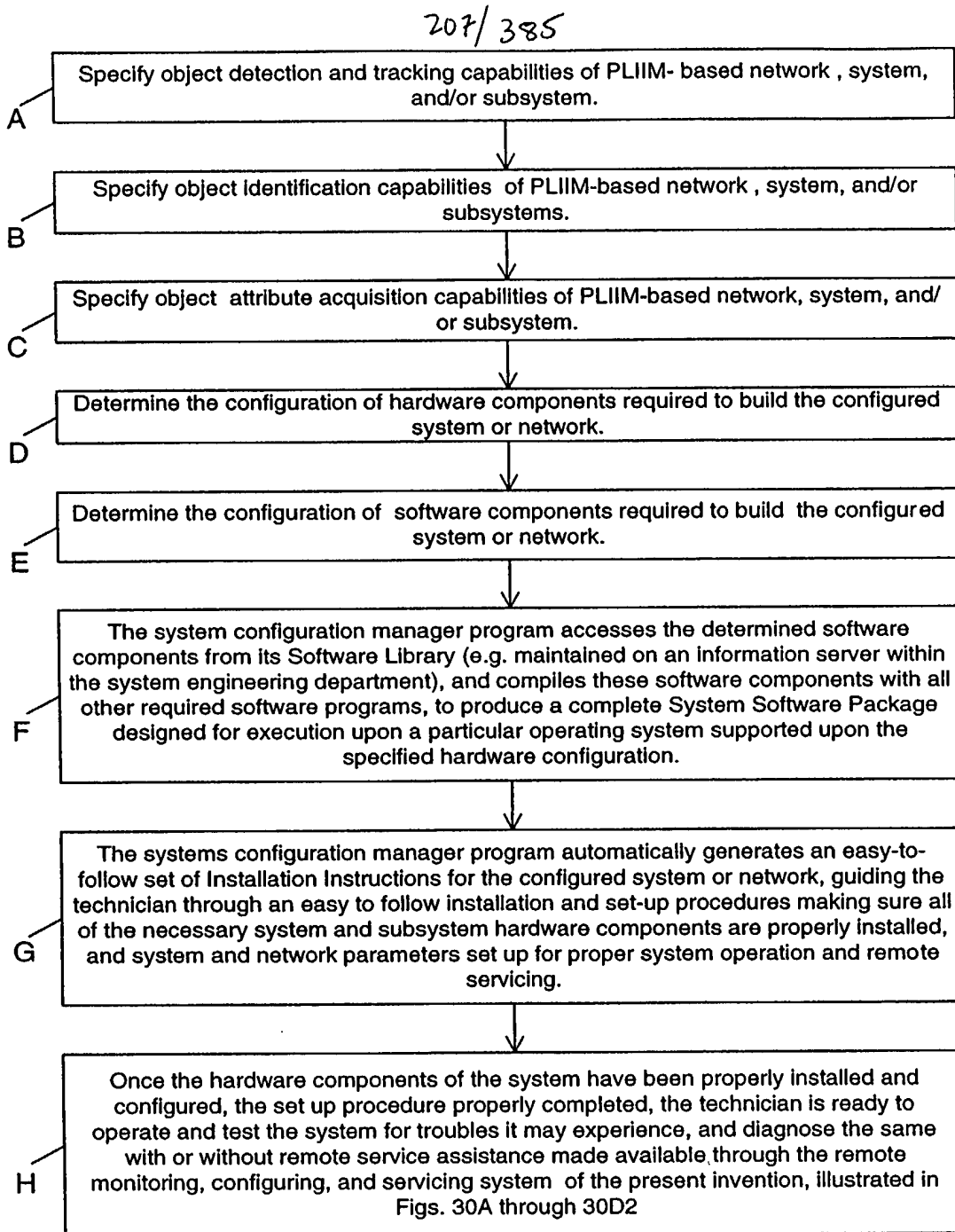


FIG. 10C

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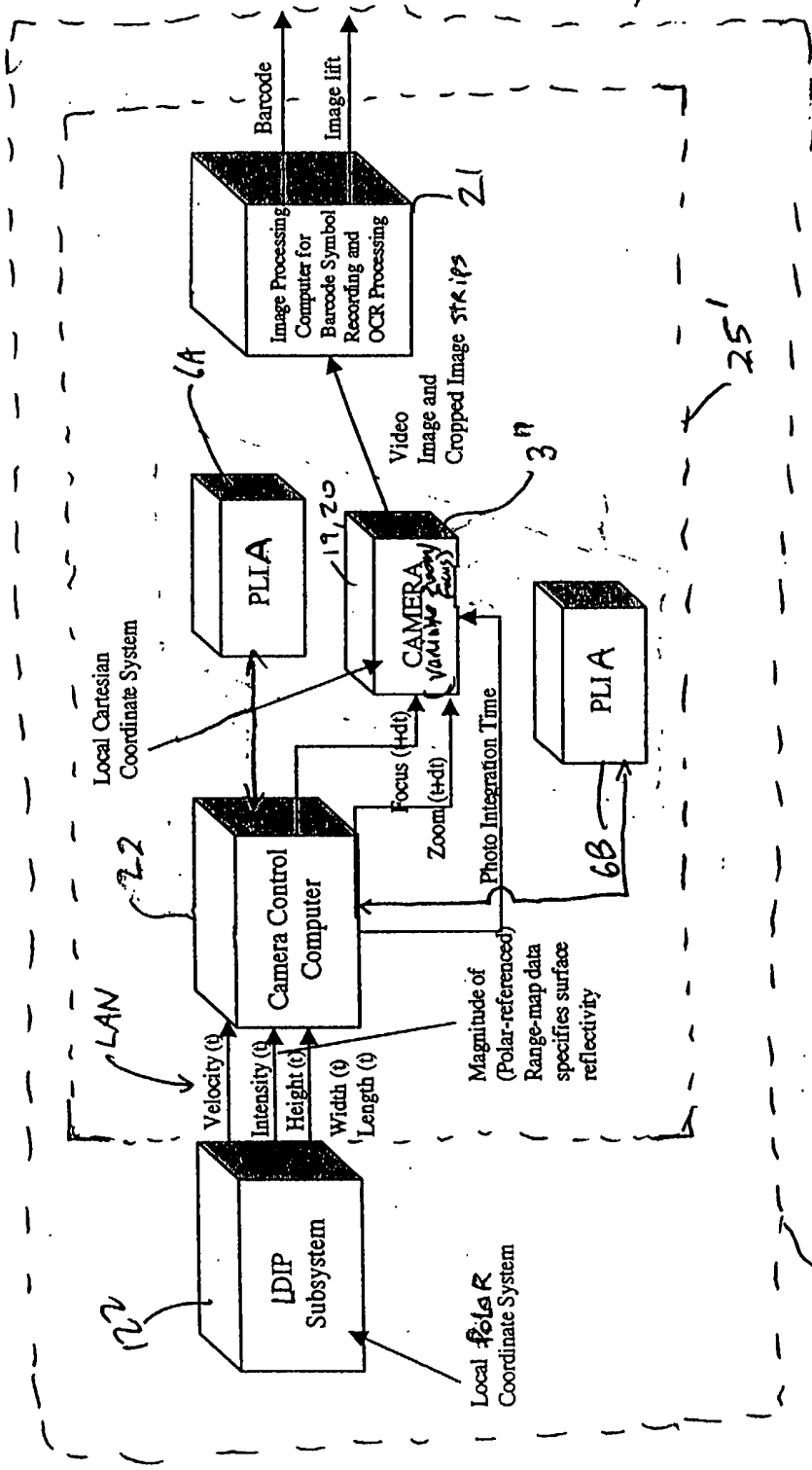


FIG. 11

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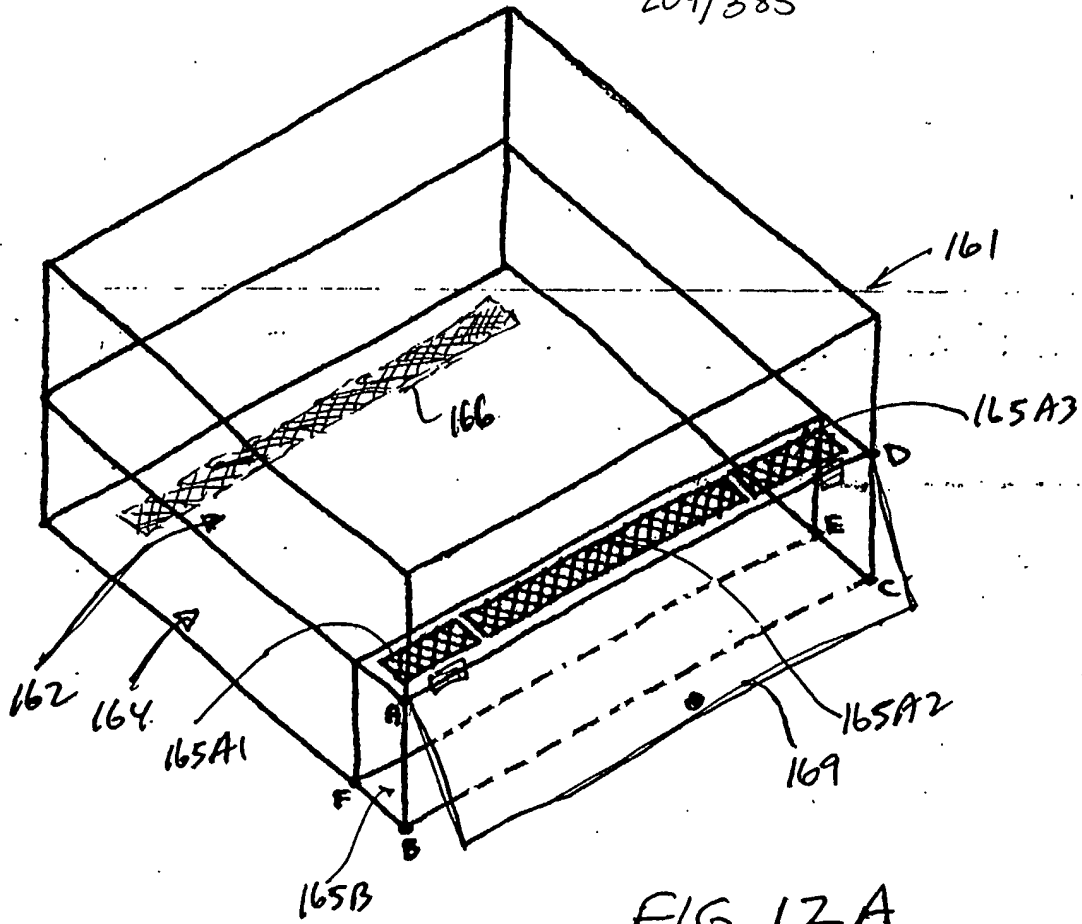


FIG. 12A

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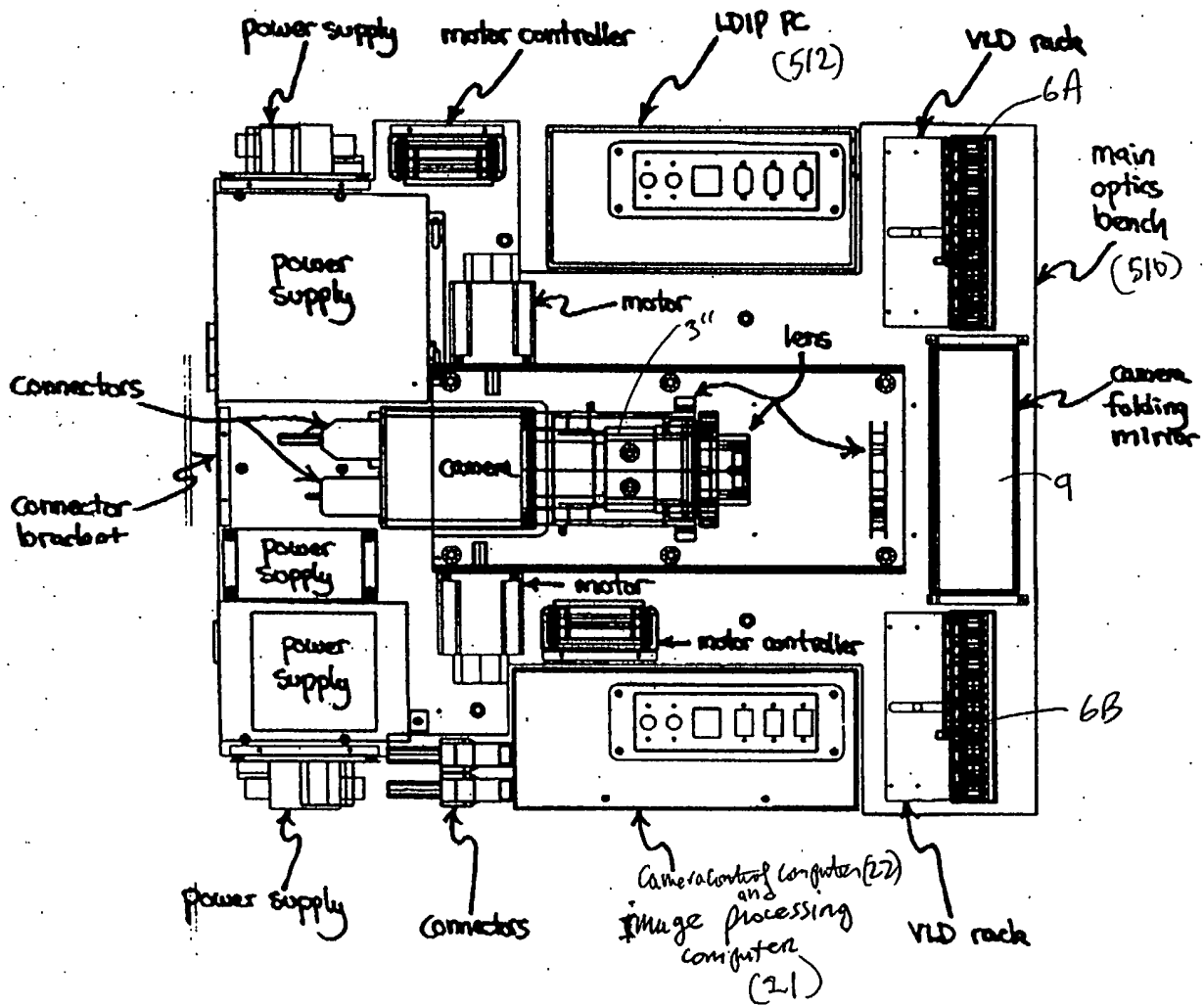


FIG. 12C

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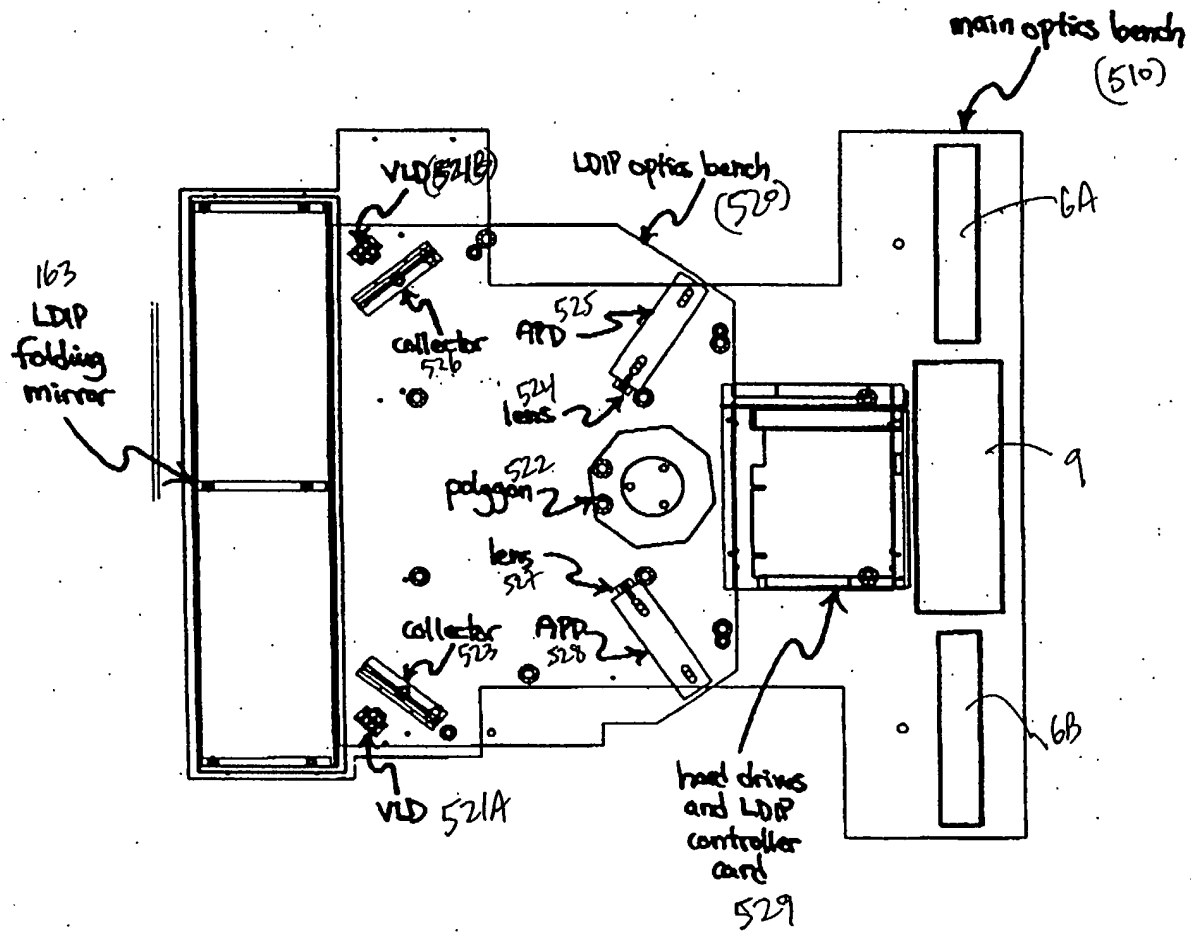


FIG. 12D

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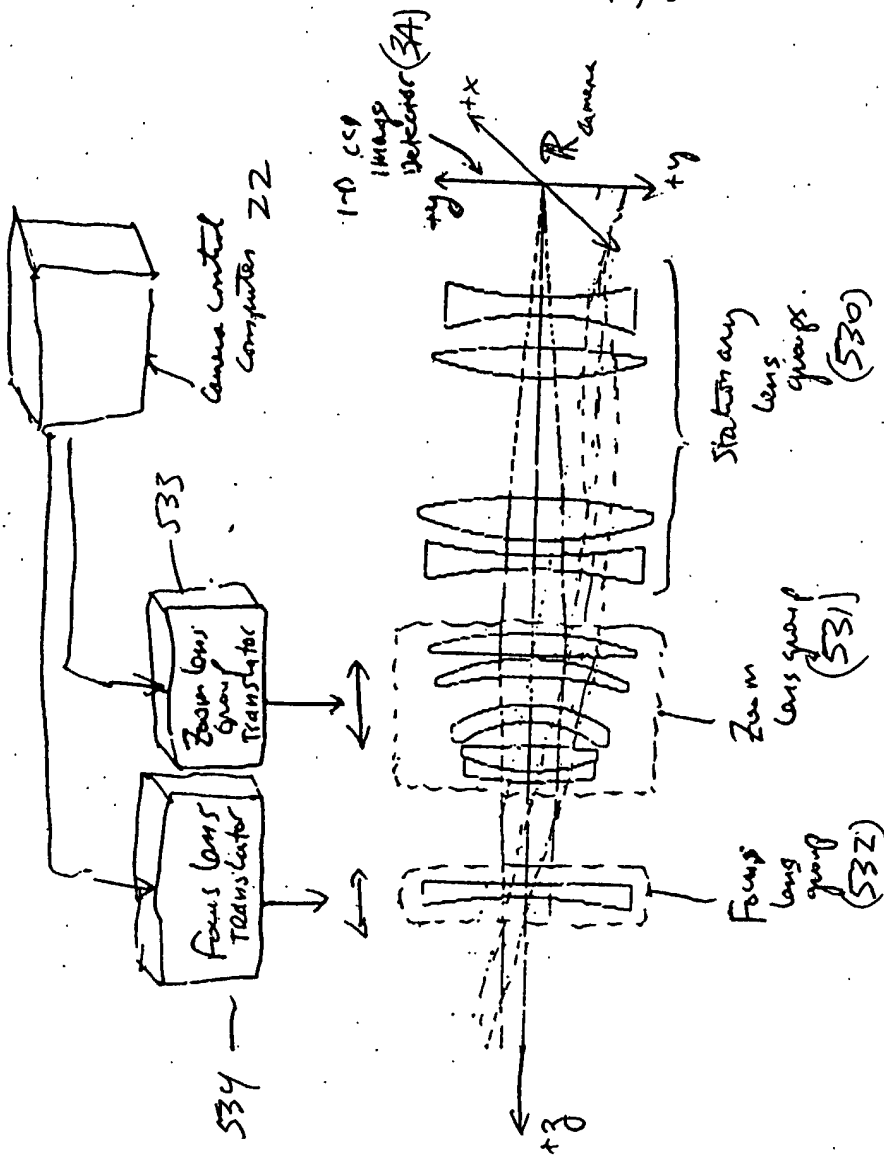


FIG. 12E

(main optics)
(Lens groups)

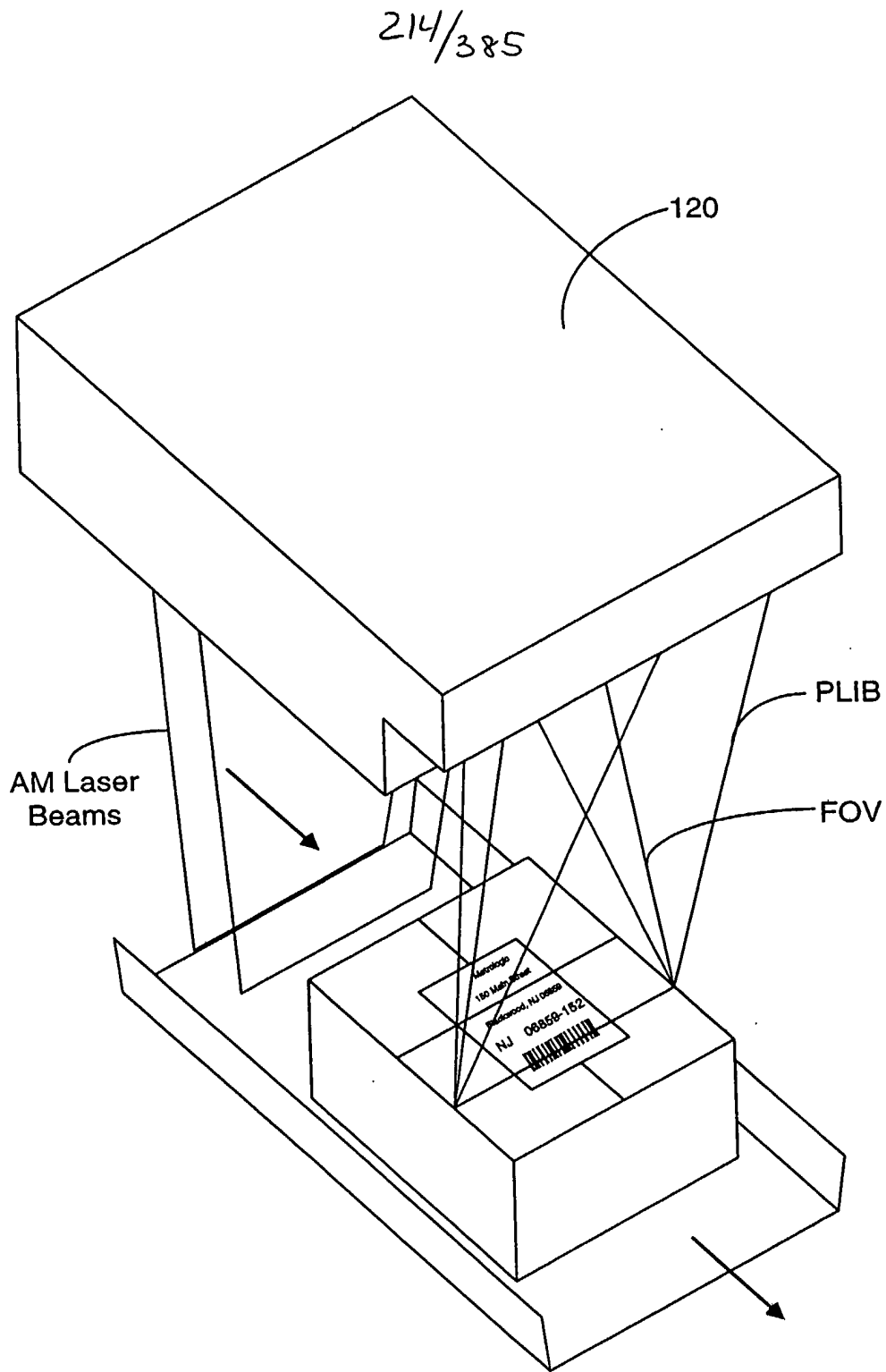


FIG. 13A

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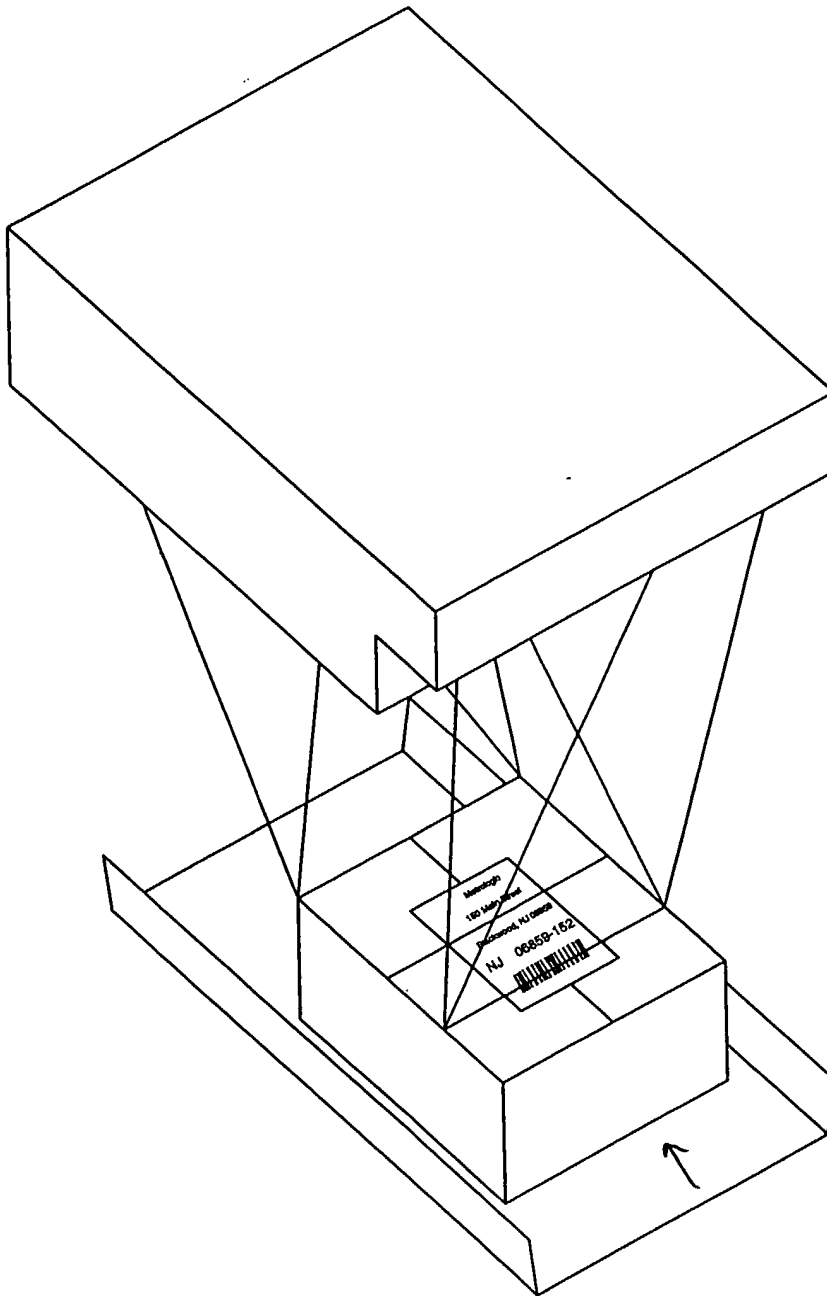


FIG. 13A

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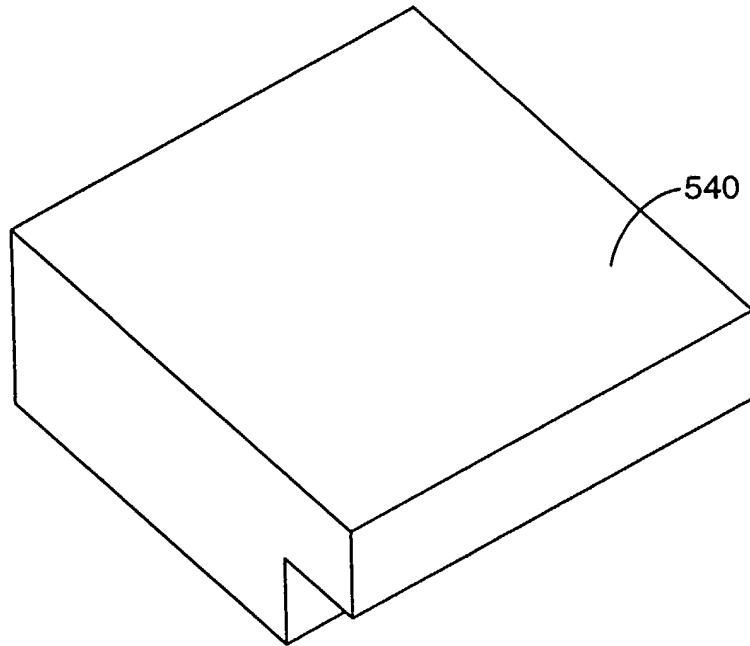


FIG. 13B

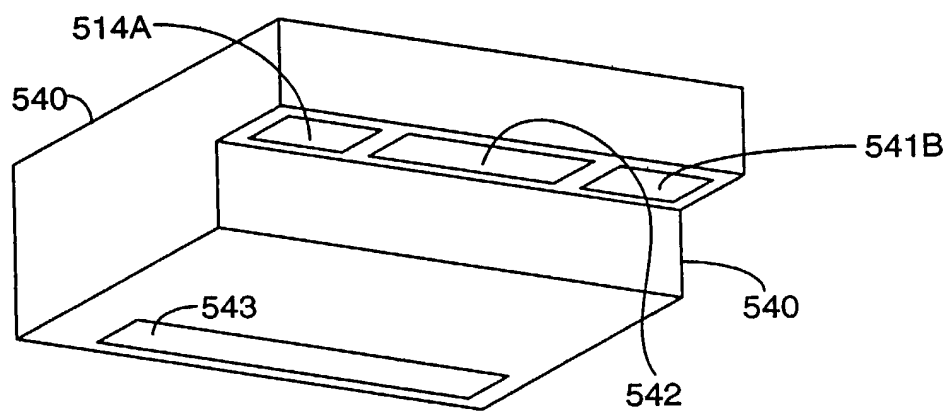


FIG. 13C

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PLLIM-BASED PACKAGE IDENTIFICATION AND
DIMENSIONING (PID) SYSTEM

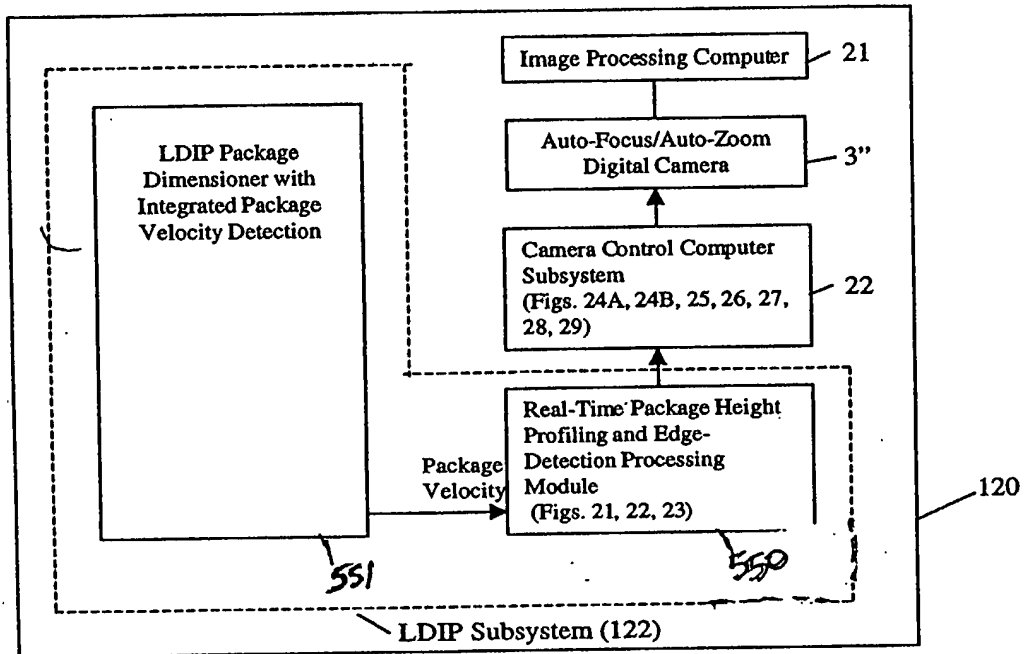


FIG. 14

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LDIP REAL-TIME PACKAGE HEIGHT PROFILE AND EDGE DETECTION METHOD

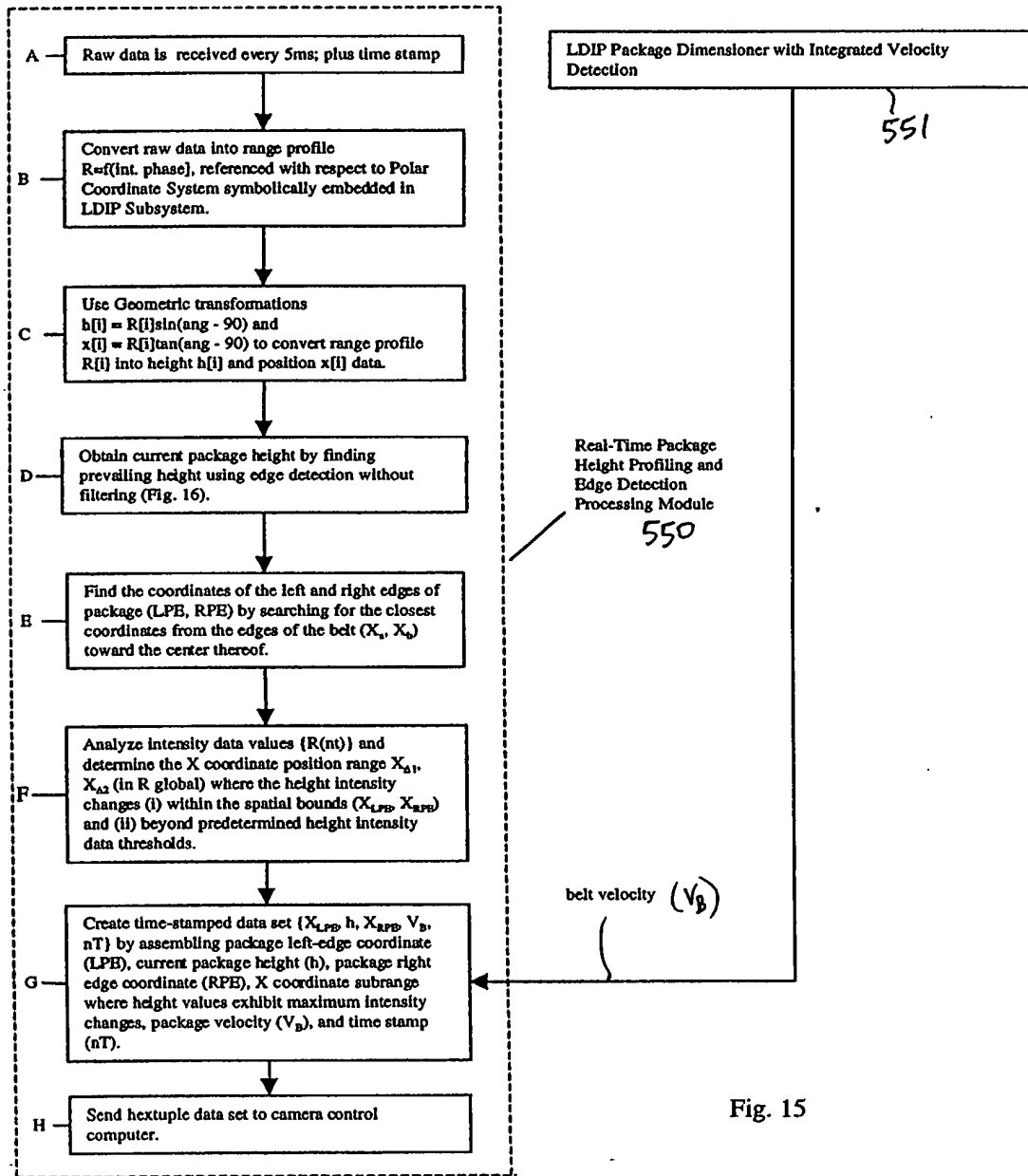


Fig. 15

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LDIP Real Time Package Edge Detection

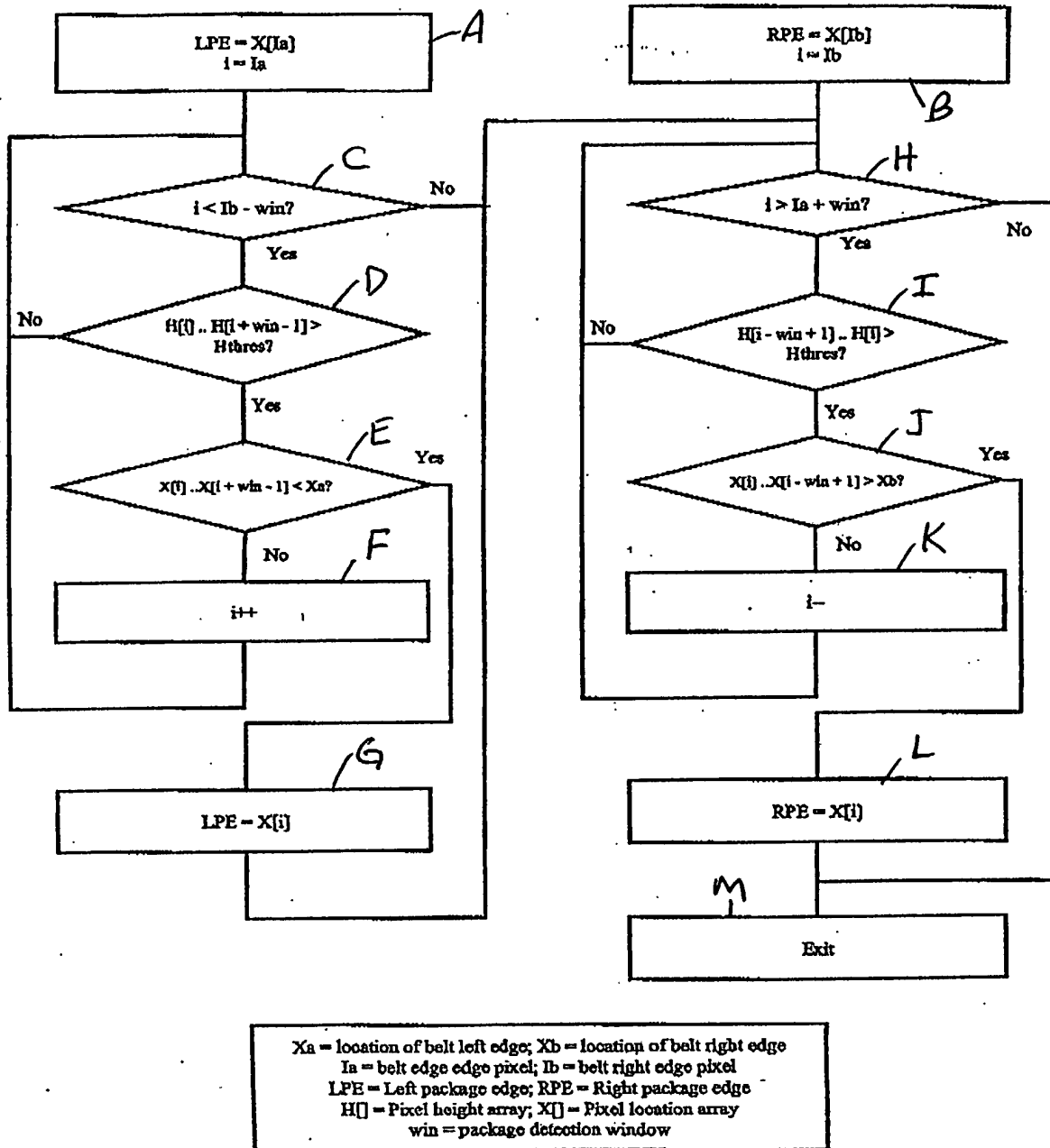


FIG. 16

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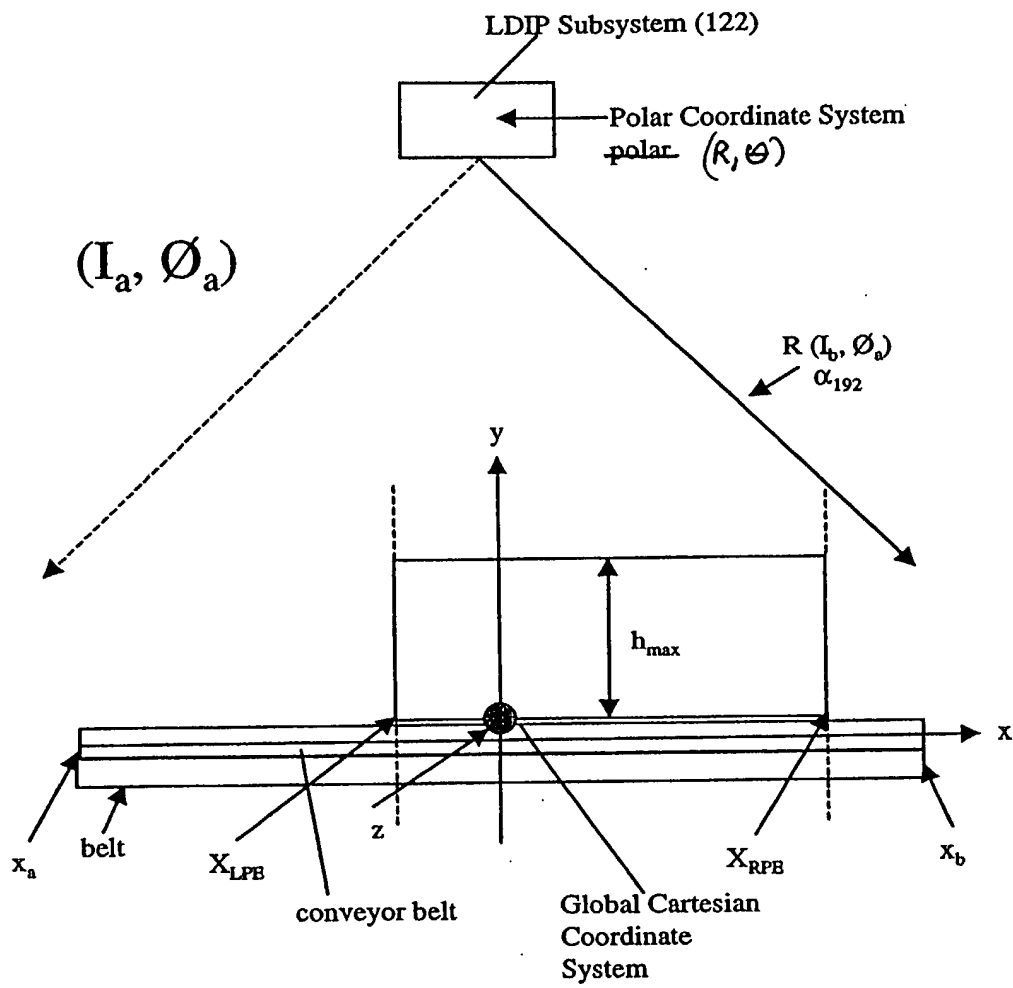


Fig. 17

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INFORMATION MEASURED AT SCAN ANGLES BEFORE COORDINATE TRANSFORMS

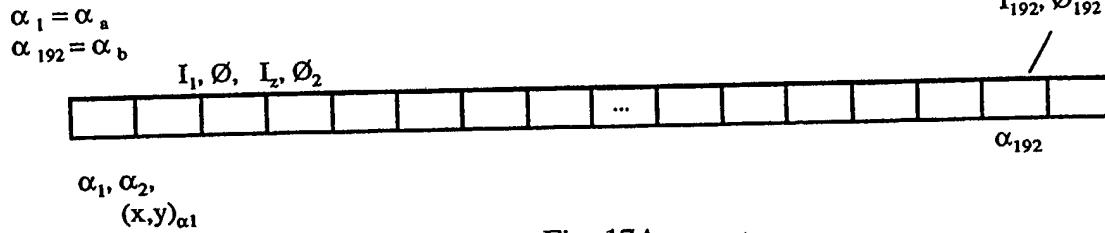


Fig. 17A

RANGE AND POLAR ANGLE MEASURES TAKEN AT SCAN ANGLE α BEFORE COORDINATE TRANSFORMS

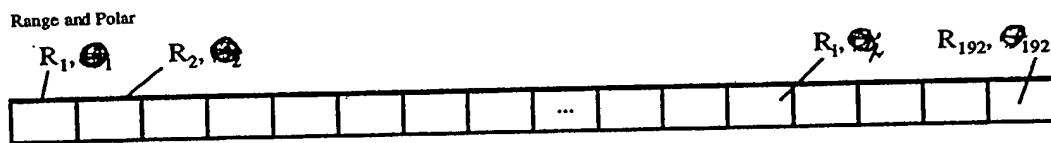


Fig. 17B

MEASURED PACKAGE HEIGHT AND POSITION VALUES AFTER COORDINATE TRANSFORMS

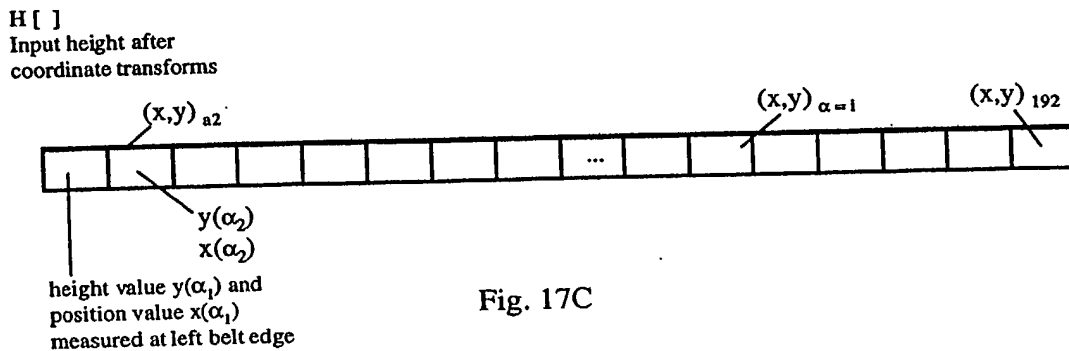
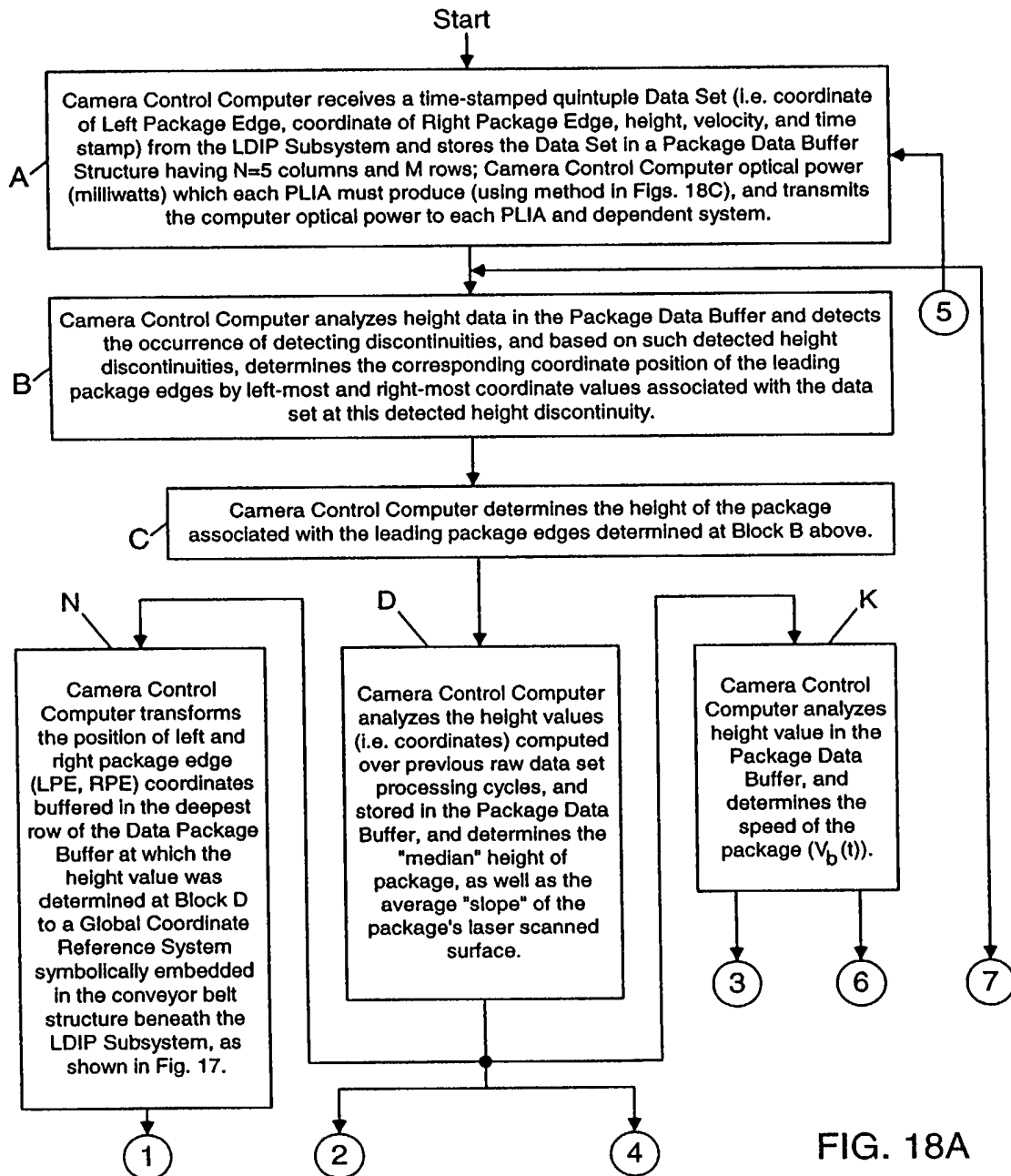


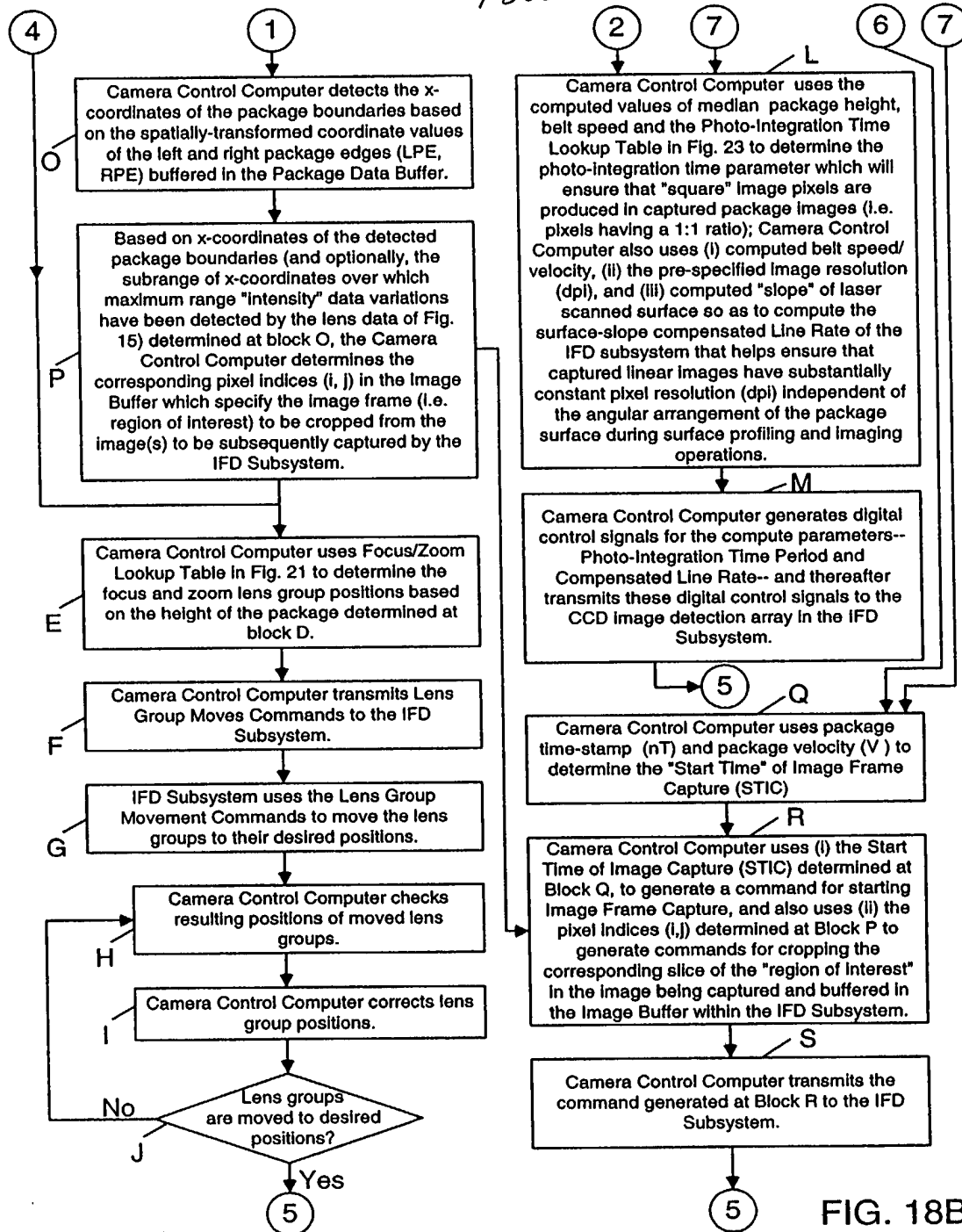
Fig. 17C

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CAMERA CONTROL PROCESS CARRIED OUT WITHIN THE CAMERA
CONTROL SUBSYSTEM OF EACH OBJECT IDENTIFICATION AND
ATTRIBUTE ACQUISITION SYSTEM OF PRESENT INVENTION



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METHOD OF COMPUTING OPTICAL OUTPUT POWER FROM CASE
DIODES IN PLANAR LASER ILLUMINATION ARRAY (PLIA) FOR
CONTROLLING CONSTANT WHITE LEVEL IN IMAGE PIXELS CAPTURED
BY PLIIM-BASED LINEAR IMAGER

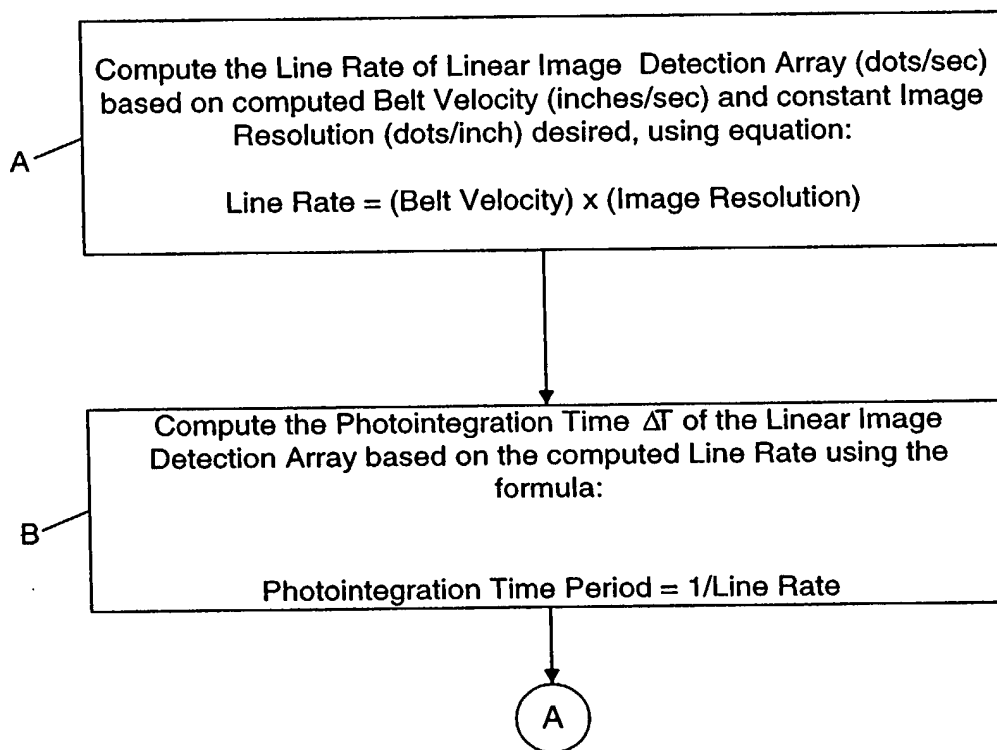


FIG. 18C1

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A



Compute the Optical Power (milliwatts) of each PLIA based on computed Photointegration Time Period (ΔT) using the following formula:

$$\text{Optical Power of VLD (milliwatts)} = \frac{\text{constant}}{\text{Photointegration Time Period } \Delta T}$$

FIG. 18C2

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METHOD OF COMPUTING COMPENSATED LINE RATE FOR CORRECTING
VIEWING-ANGLE DISTORTION OCCURING IN IMAGES OF OBJECT
SURFACES CAPTURED AS OBJECT SURFACES MOVE PAST PLIIM-
BASED LINEAR IMAGER AT NON-ZERO SKEWED ANGLE

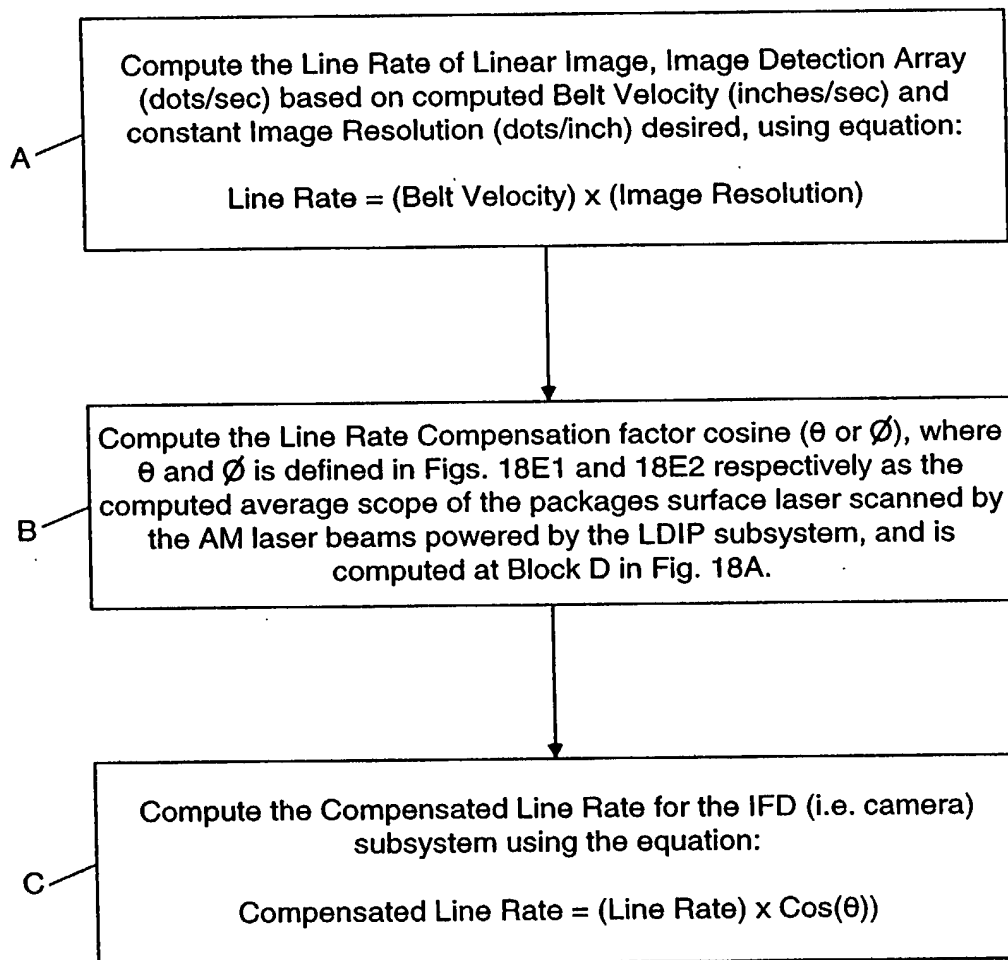


FIG. 18D

CASE 1:
Top Down Imaging

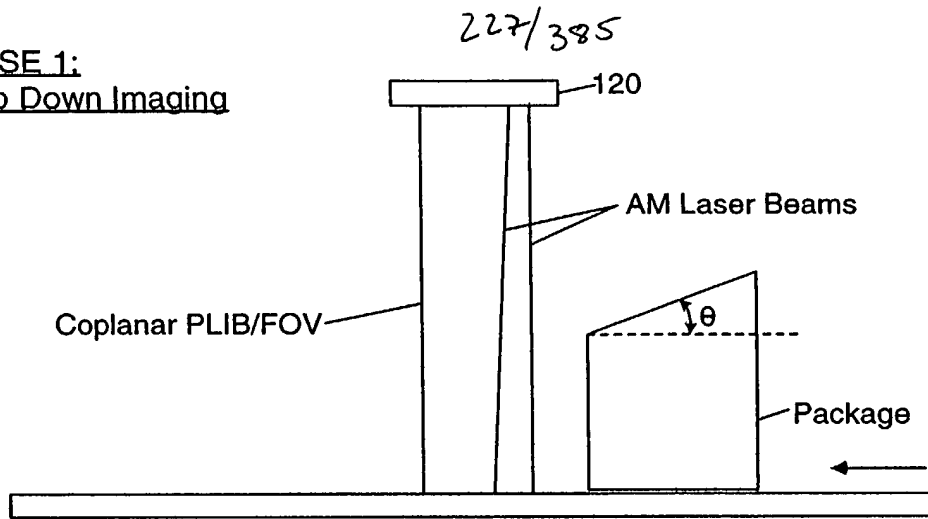


FIG. 18E1

CASE 2:
Side Imaging

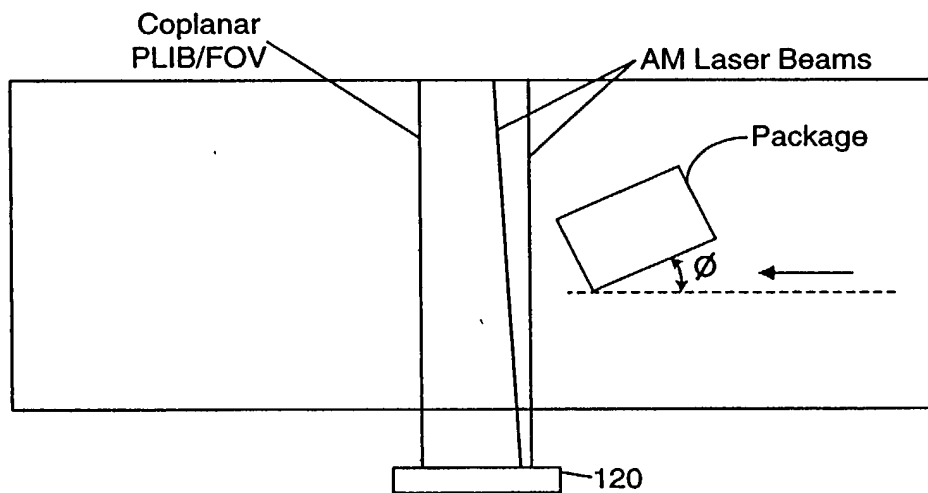
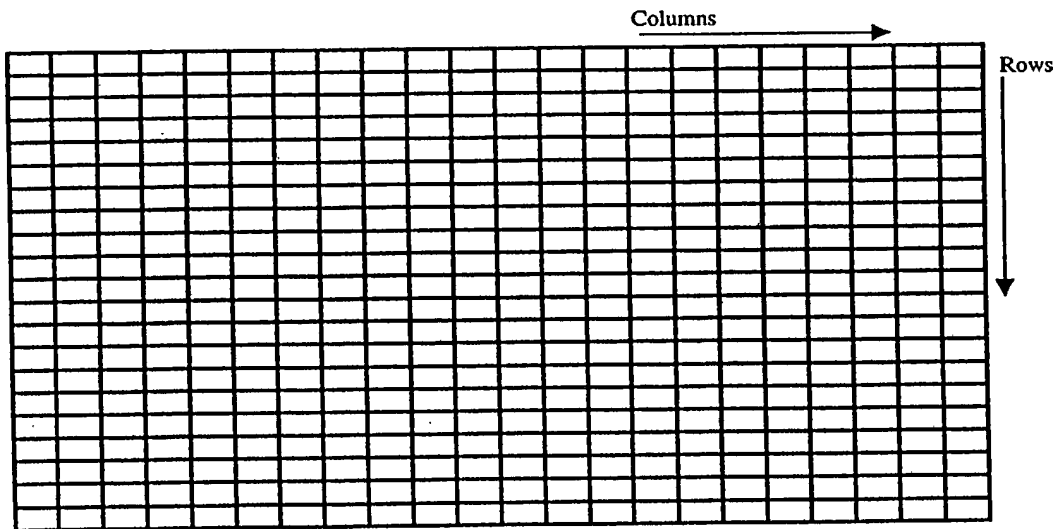


FIG. 18E2

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X coordinate subrange where
maximum range "intensity"
variations have been detected

Left Package Edge (LDE)	Package Height (h)	Right Package Edge (RPE)	Package Velocity	Time-stamp (nT)	
					Row 1
					Row 2
					Row 3
					Row 4
					Row 5
					Row M
Package Data Buffer (FIFO)					
		Fig. 19			



Camera Pixel Data Buffer
pixel indices (i,j)

Fig. 20

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Zoom and Focus Lens Group position
Look-up Table

Distance from Camera H (mm)	Zoom group distance (mm) Y (Zoom)	Focus group distance (mm) Y (Focus)
1000	21.57489228	2.47E-05
1100	19.38089696	10.99009783
1200	17.10673434	20.65783177
1300	14.77137314	29.10917002
1400	12.39153565	36.47312595
1500	9.979114358	42.87845436
1600	7.540639114	48.44003358
1700	5.078794775	53.25495831
1800	2.595989366	57.40834303
1900	0.099972739	60.98883615

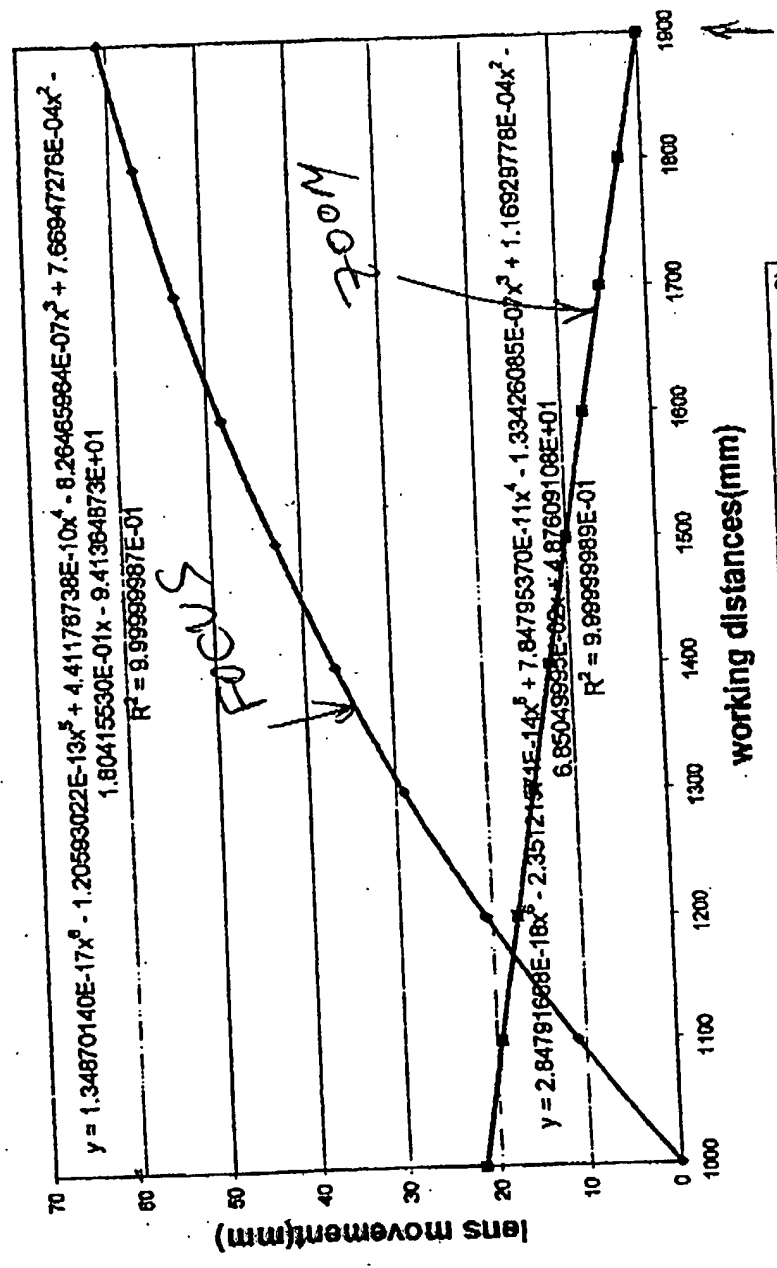
(use interpolation techniques for walking distances between listed points in table)

FIG. 21.

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* Note: On focal distance & zoom (left hand graph) in camera lens are coupled (inter-dependent) in camera has a fixed aperture F5.6
this camera is on bedmount

Focus and Zoom lens movement vs. working distances



↑ (inches) 11 above conveyor belt
← package height above conveyor
Conveyor-belt Surface

FIG. 22A

FIG. 22B

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3D Surface Profile And High Resolution
Linear Image Data Capture
At PLIIM-Based Profiling
And Imaging System

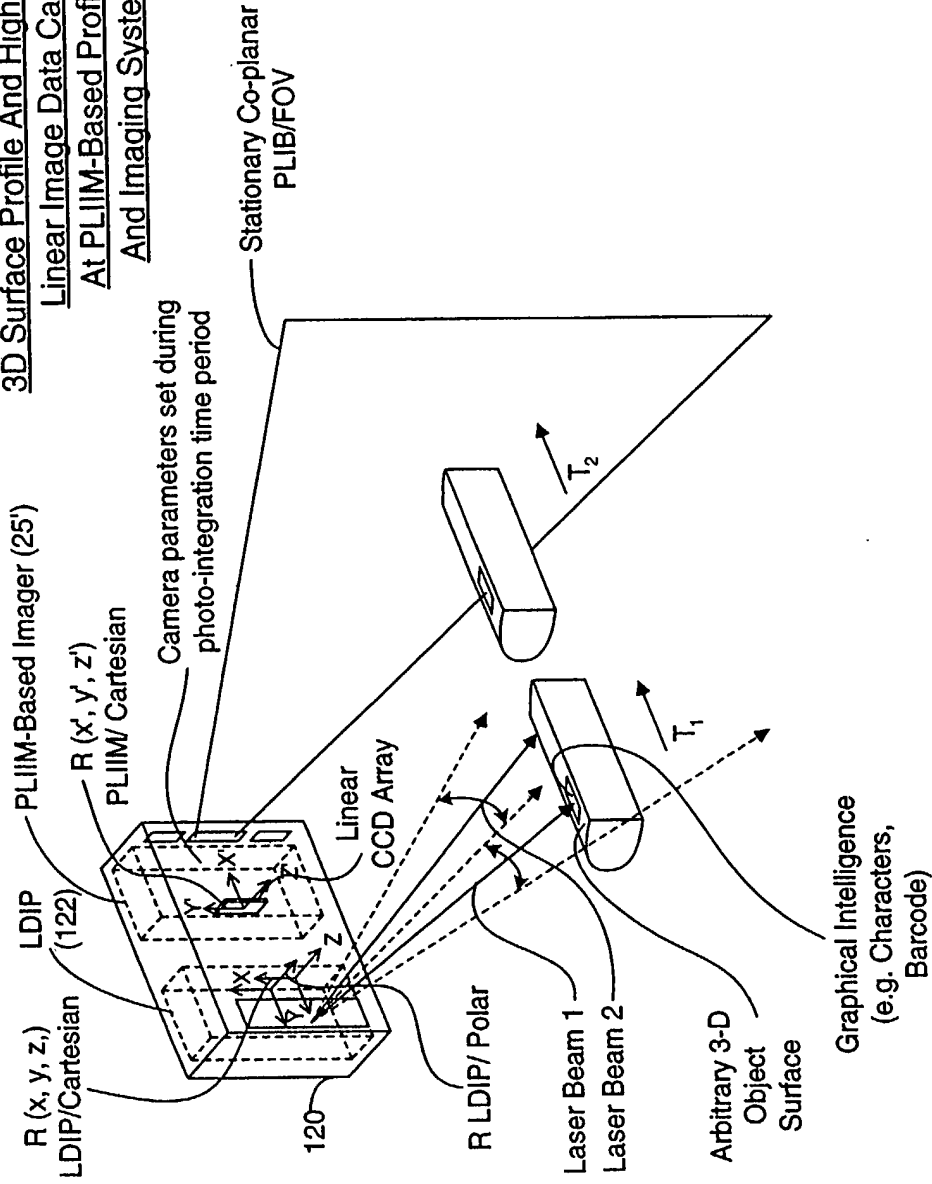


FIG. 23A

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Geometrical Modelling Of Arbitrary 3-D Object Surface
At Image Processing Computer

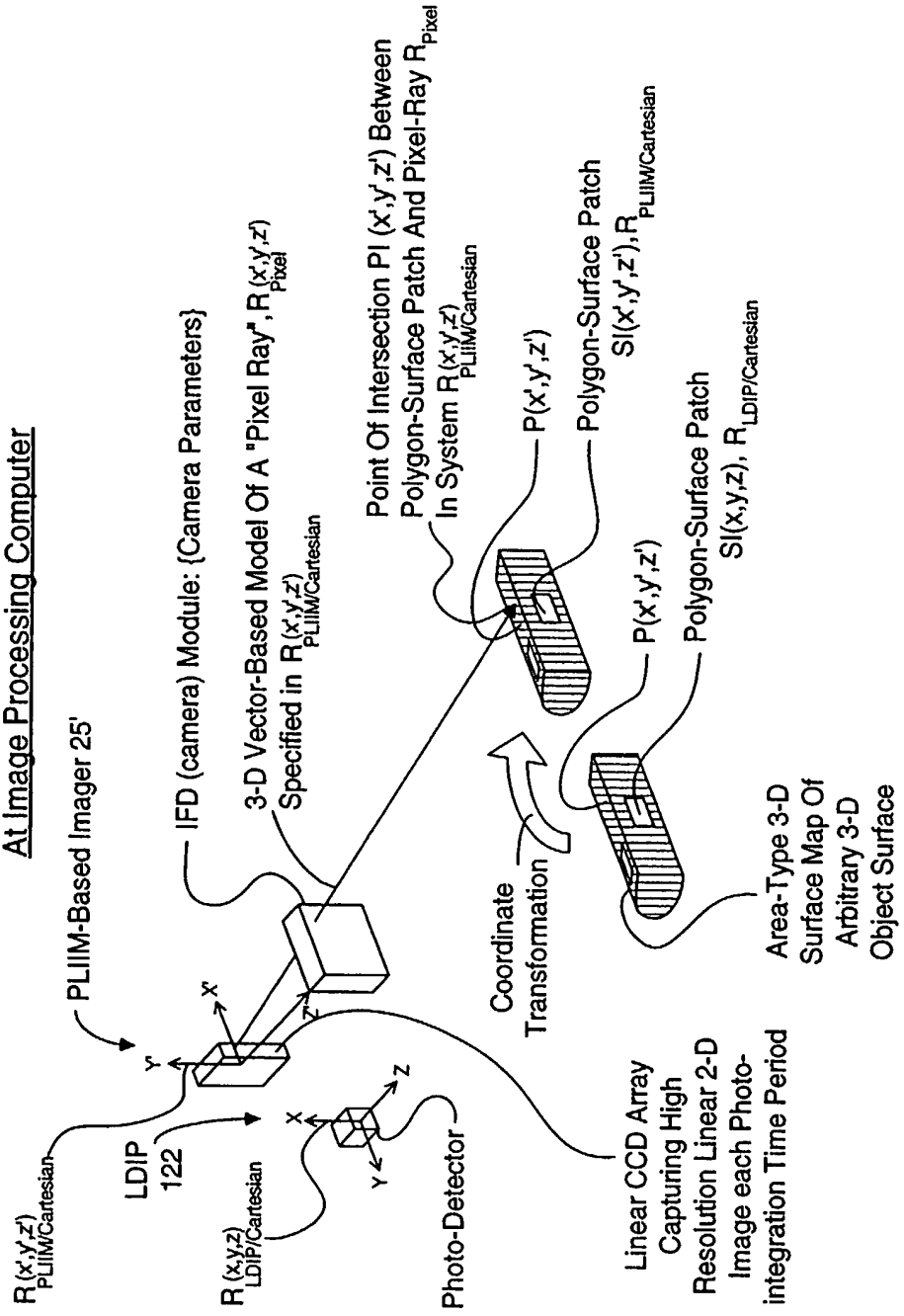


FIG. 23B

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METHOD OF AND APPARATUS FOR PERFORMING AUTOMATIC
RECOGNITION OF GRAPHICAL INTELLIGENCE CONTAINED IN 2-D
IMAGES CAPTURED FROM ARBITRARY 3-D OBJECT SURFACES

STEP 1: At the unitary PLIIM-based object imaging and profiling system, use the laser doppler imaging and profiling (LDIP) subsystem employed therein to (i) consecutively capture a series of linear 3-D surface profile maps on a targeted arbitrary (e.g. non-planar or planar) 3-D object surface bearing forms of graphical intelligence and (ii) measure the velocity of the arbitrary 3-D object surface, wherein the polar coordinates of each point in the captured linear 3-D surface profile map are specified in a local polar coordinate system $R_{LDIP/polar}$, symbolically embedded within the LDIP subsystem.

A

STEP 2: At the unitary PLIIM-based object imaging and profiling system, use coordinate transforms to automatically convert the polar coordinates of each point $p(\alpha, R)$ in the captured linear 3-D surface profile map into x, y, z Cartesian coordinates specified as $p(x, y, z)$ in a local Cartesian coordinate system $R_{LDIP/Cartesian}$, symbolically embedded within the LDIP subsystem.

B

STEP 3: At the unitary PLIIM-based object imaging and profiling system, use the PLIIM-based imager employed therein to consecutively capture high-resolution linear 2-D images of the arbitrary 3-D object surface bearing forms of graphical intelligence (e.g. symbol character strings), wherein (i) the x', y' coordinates of each pixel in each said captured high-resolution linear 2-D image is specified in local Cartesian coordinate system $R_{PLIIM/Cartesian}$ symbolically embedded within the PLIIM-based imager, and (ii) the intensity value of the pixel $I(x', y')$ is associated with the x', y' Cartesian coordinates of the image detection element in the linear image detection array at which the pixel is detected, and (iii) wherein also the planar laser illumination beam (PLIB) of the PLIIM-based imager is spaced from the amplitude modulated (AM) laser scanning beam of the LDIP subsystem is about D centimeters.

C

A

FIG. 23C1

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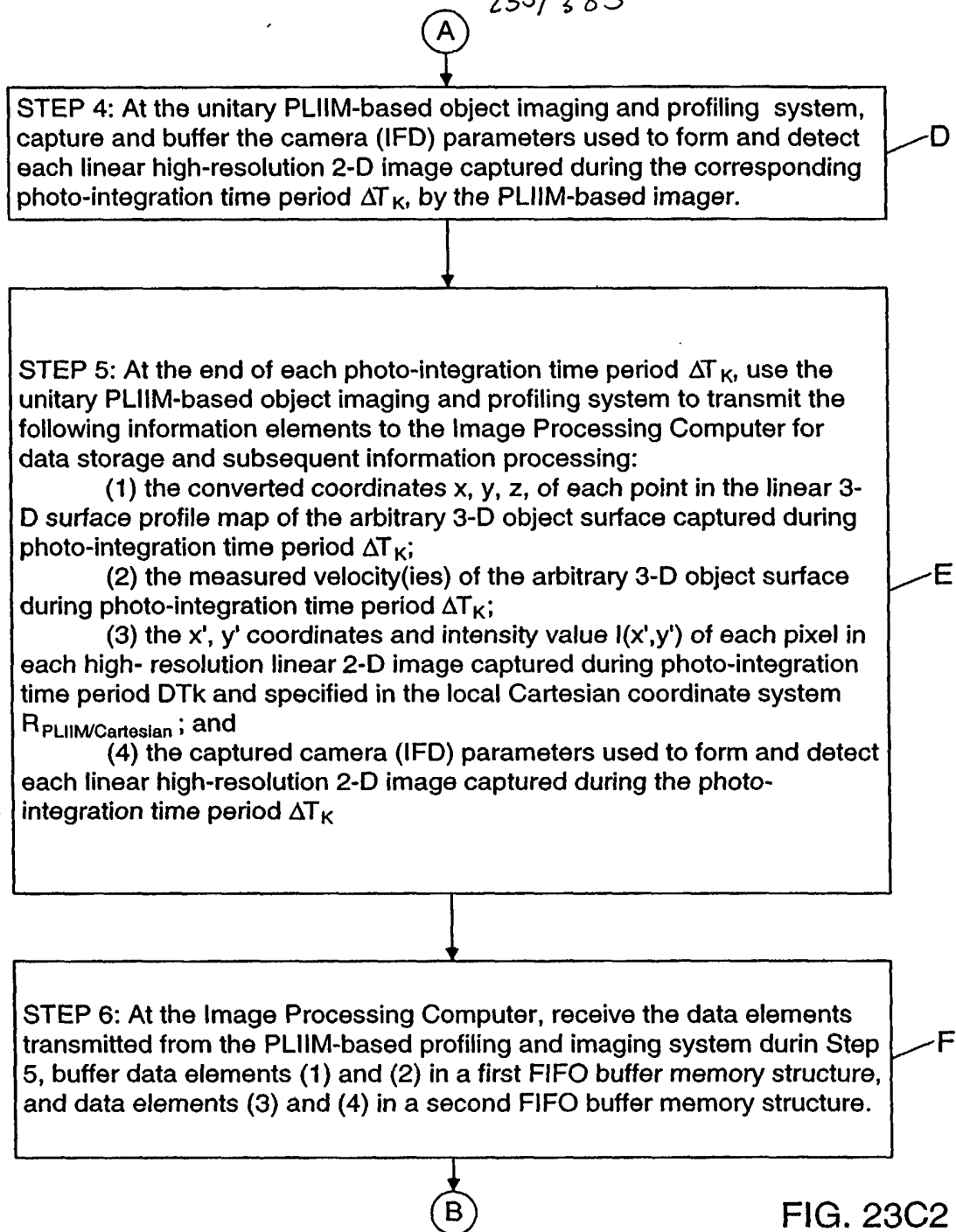


FIG. 23C2

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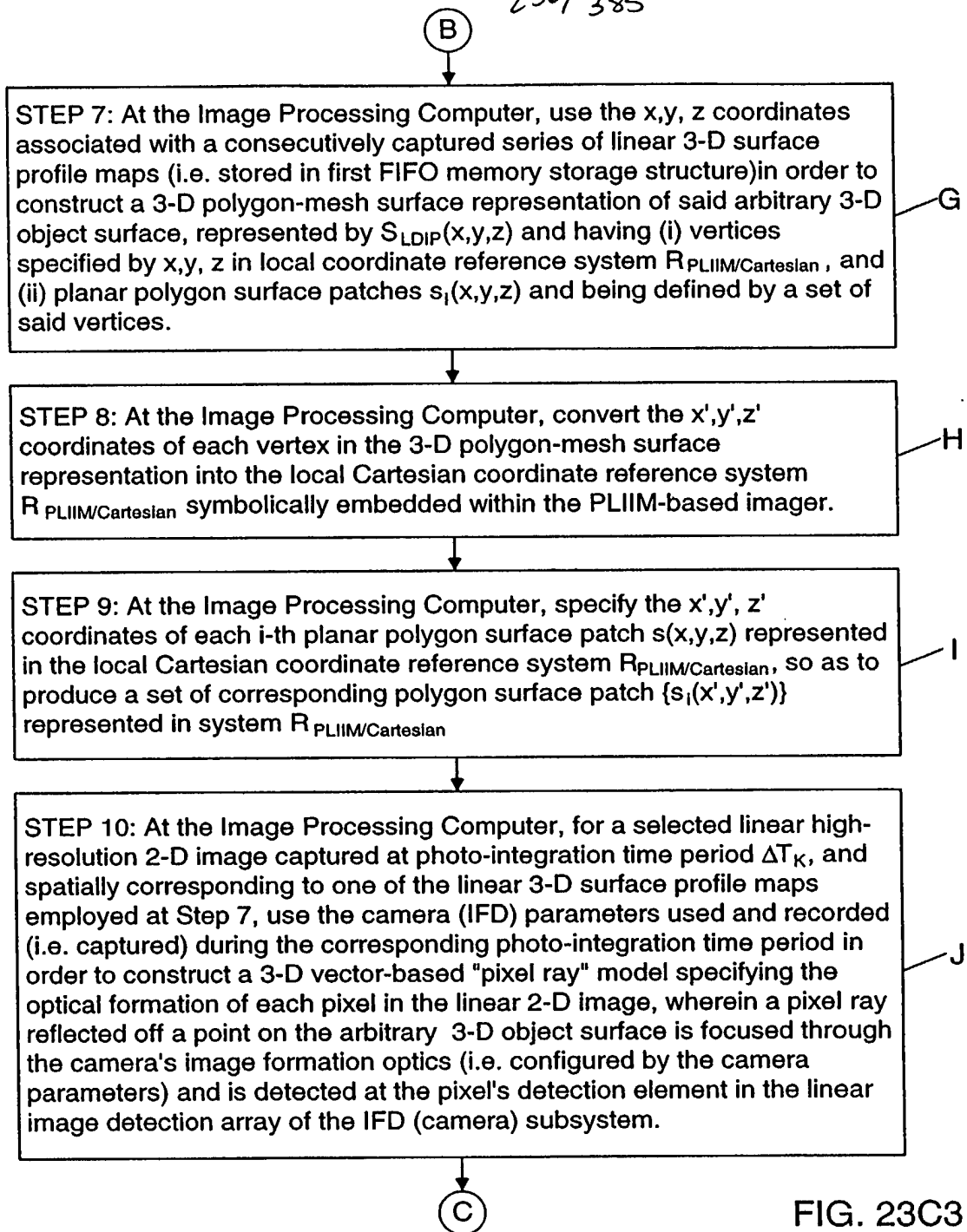


FIG. 23C3

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C

STEP 11: At the Image Processing Computer, for each laser beam ray (producing one of the pixels in said selected linear 2-D image), (i) determine which polygon surface patch $s_i(x, y, z)$ the pixel ray intersects, (ii) compute the x, y, z coordinates of the point of intersection (POI) between the pixel ray and the polygon surface patch represented in Cartesian coordinate reference system $R_{PLIIM/Cartesian}$, and (iii) designate the computed set of points of intersection as $\{p_i(x, y, z)\}$.

K

STEP 12: At the Image Processing Computer, for each laser beam ray passing through a determined polygon surface patch $s(x', y', z')$ at a computed point of intersection $p_i(x, y, z)$, assign the intensity value $I(x', y')$ of the pixel ray to the x', y', z' coordinates of the point of intersection, thereby producing a linear high-resolution 3-D image comprising a 2-D array of pixels, each said pixel pixel having as its attributes (i) an Intensity value $I(x', y', z')$ and (ii) coordinates x', y', z' specified in the local Cartesian coordinate reference system $R_{PLIIM/Cartesian}$.

L

STEP 13: Put the computed linear high-resolution 3-D image in a third FIFO memory storage structure in the image processing computer.

M

STEP 14: Repeat Steps 1-6 to update the first and second FIFO data queues maintained in the image processing computer, and Steps 7-13 to update the consecutively computed linear high-resolution 3-D image stored in the third FIFO memory storage structure.

N

STEP 15: Assemble in an image buffer in the image processing computer, a set of consecutively computed linear high-resolution 3-D images retrieved from the third FIFO data storage device so as to construct an "area-type" high-resolution 3-D image of said arbitrary 3-D object surface.

O

D

FIG. 23C4

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D

STEP 16: At the Image Processing Computer, map the intensity value $I(x', y', z')$ of each pixel in the computed area-type 3-D image onto the x', y', z' coordinates of the points on a uniformly-spaced apart "grid" positioned perpendicular to the optical axis of the camera subsystem (i.e. to model the 2-D planar substrate on which the forms of graphical intelligence was originally rendered), wherein said mapping process involves using an intensity weighing function based on the x', y', z' coordinate values of each pixel in the area-type high-resolution 3-D image, thereby producing an area-type high-resolution 2-D image of the 2-D planar substrate surface bearing said forms of graphical intelligence (e.g. symbol character strings).

P

STEP 17: At the Image Processing Computer, use said OCR algorithm to perform automated recognition of graphical intelligence contained in said area-type high-resolution 2-D image of said 2-D planar substrate surface so as to recognize said graphical intelligence and generate symbolic knowledge structures representative thereof.

Q

STEP 18: Repeat Steps 1-17 as often as required to recognize changes in graphical intelligence on the arbitrary moving 3-D object surface.

R

FIG. 23C5

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600 feet per minute
(FPM)

Photo-Integration Time Look-up Table

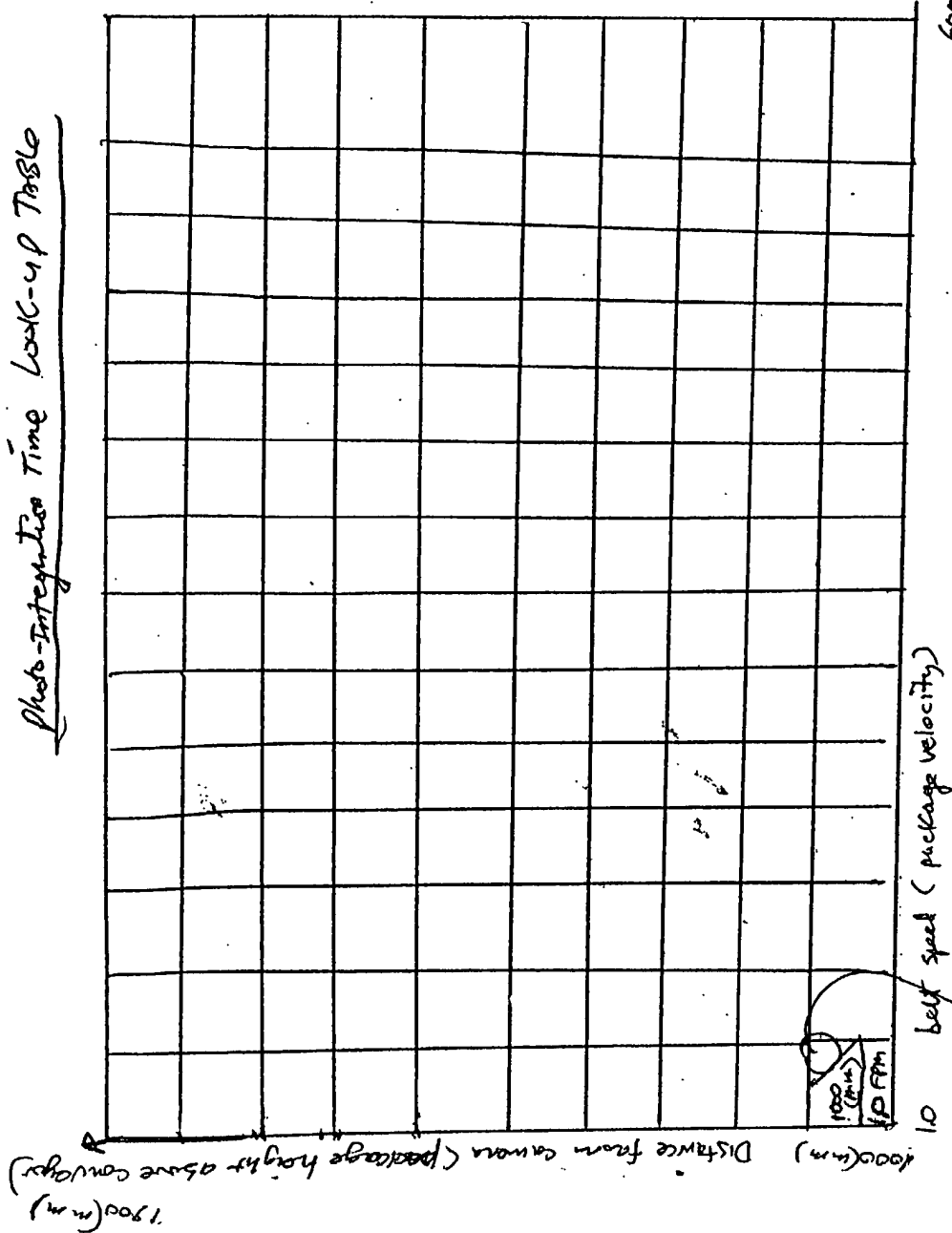


Fig. 22B

Photo-integration
time value that
ensures square image pixels
(1:1 aspect ratio)

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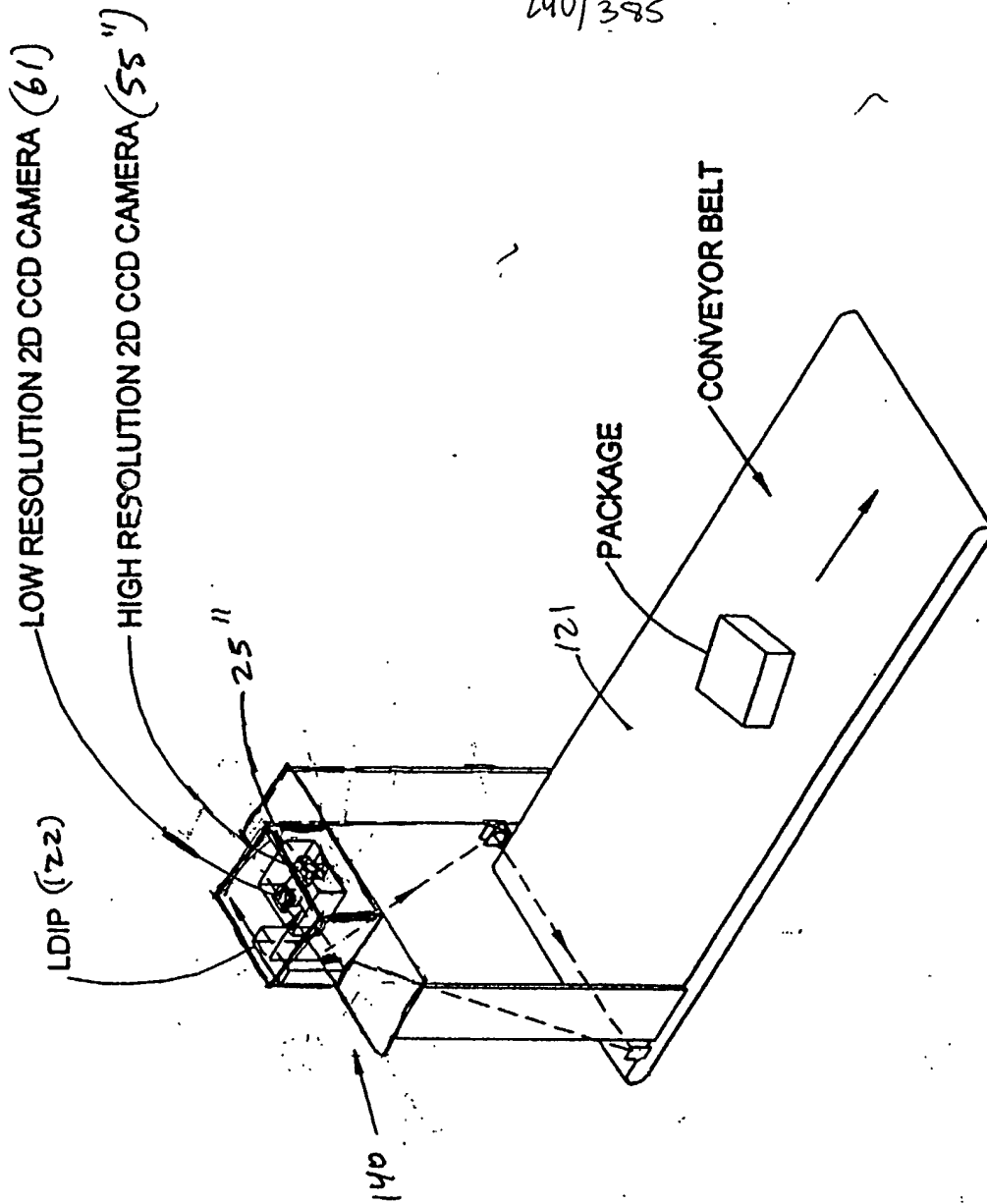


FIG 24

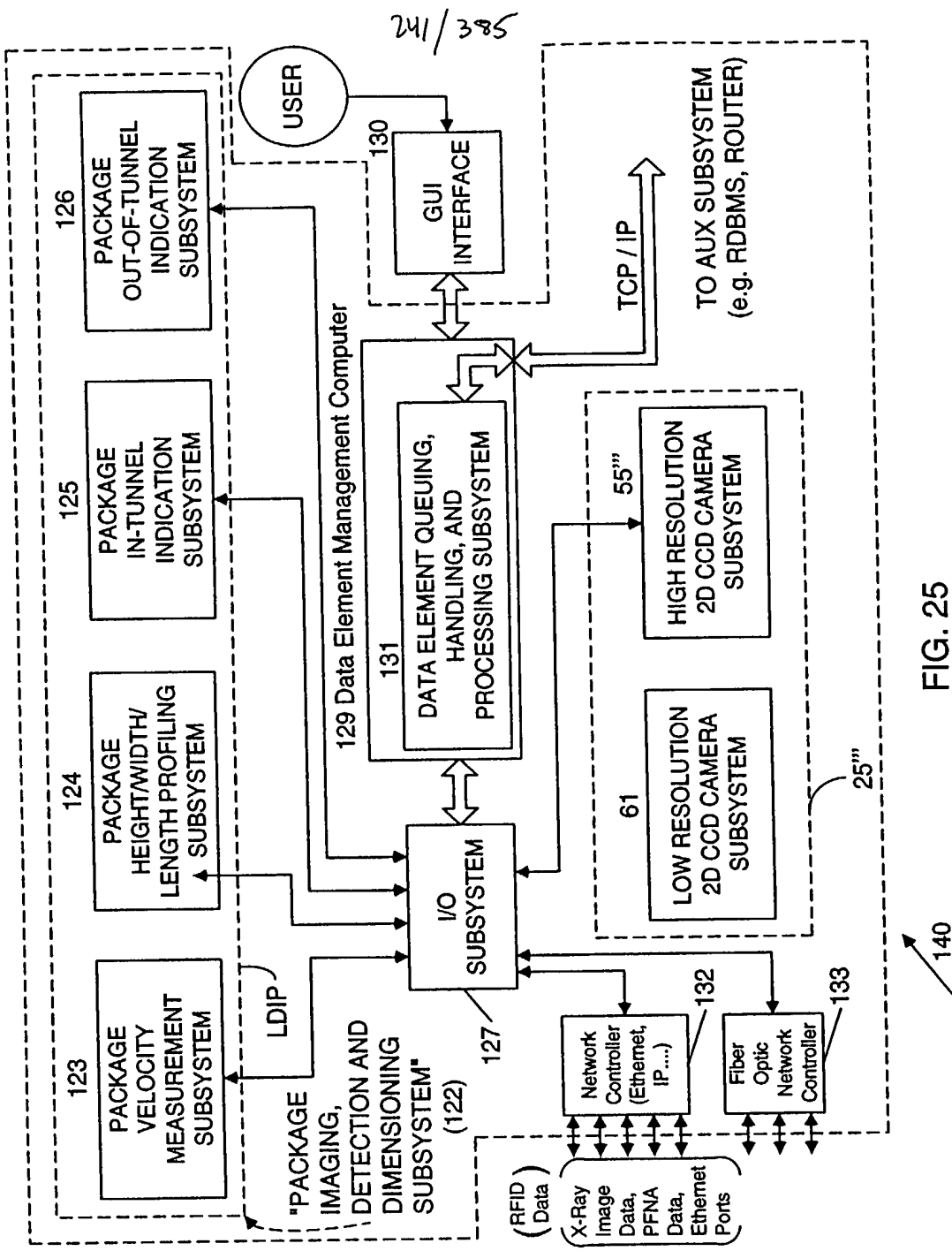


FIG. 25

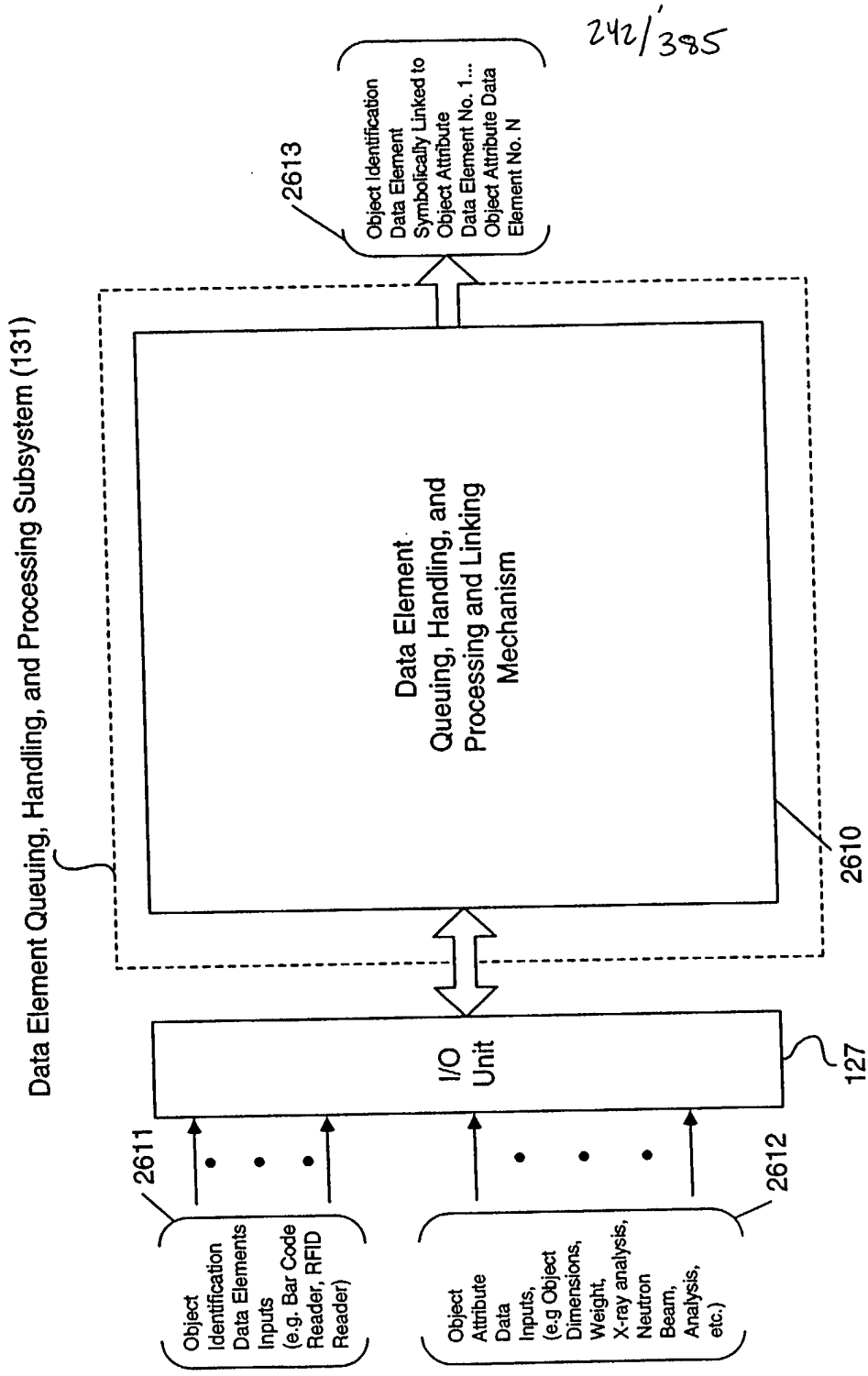


FIG. 25A

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Primary Network:
and/ or System
Functions:

- A. Specification of Object Detection and Tracking Capability of System
- B. Specification of Object Identification Capability of System
- C. Specification of Object Attribute Acquisition Capability of System

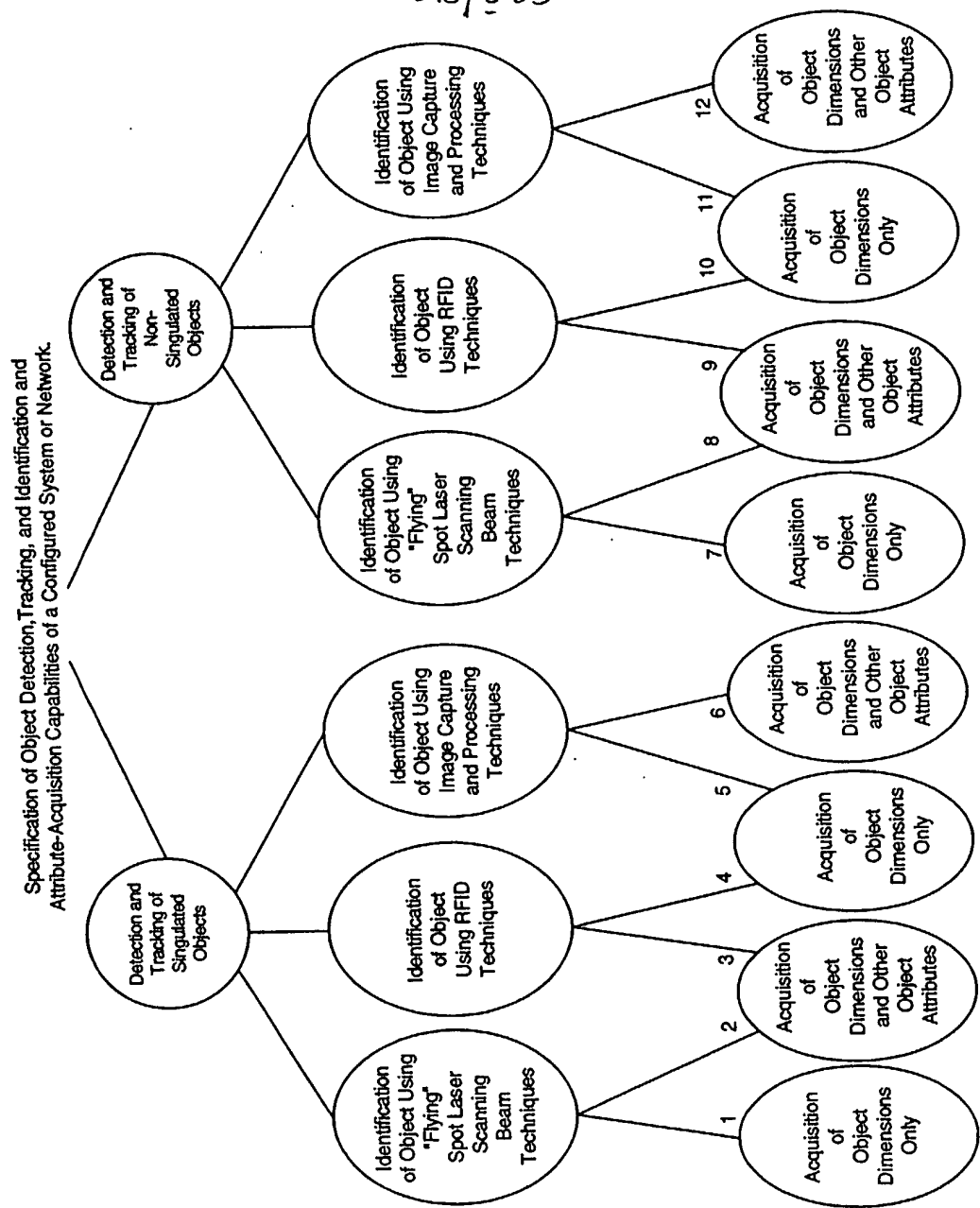


FIG. 25B

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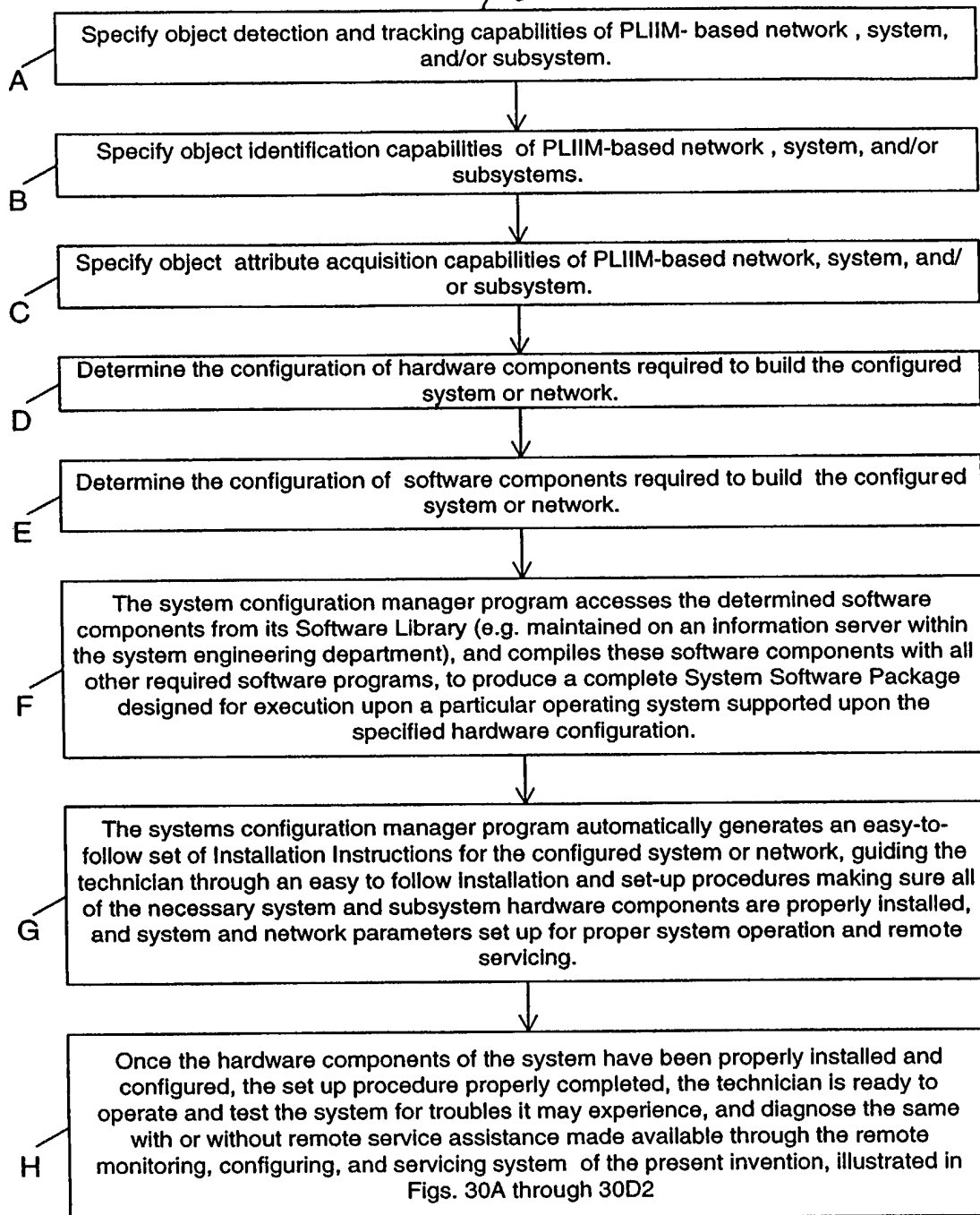


FIG. 25C

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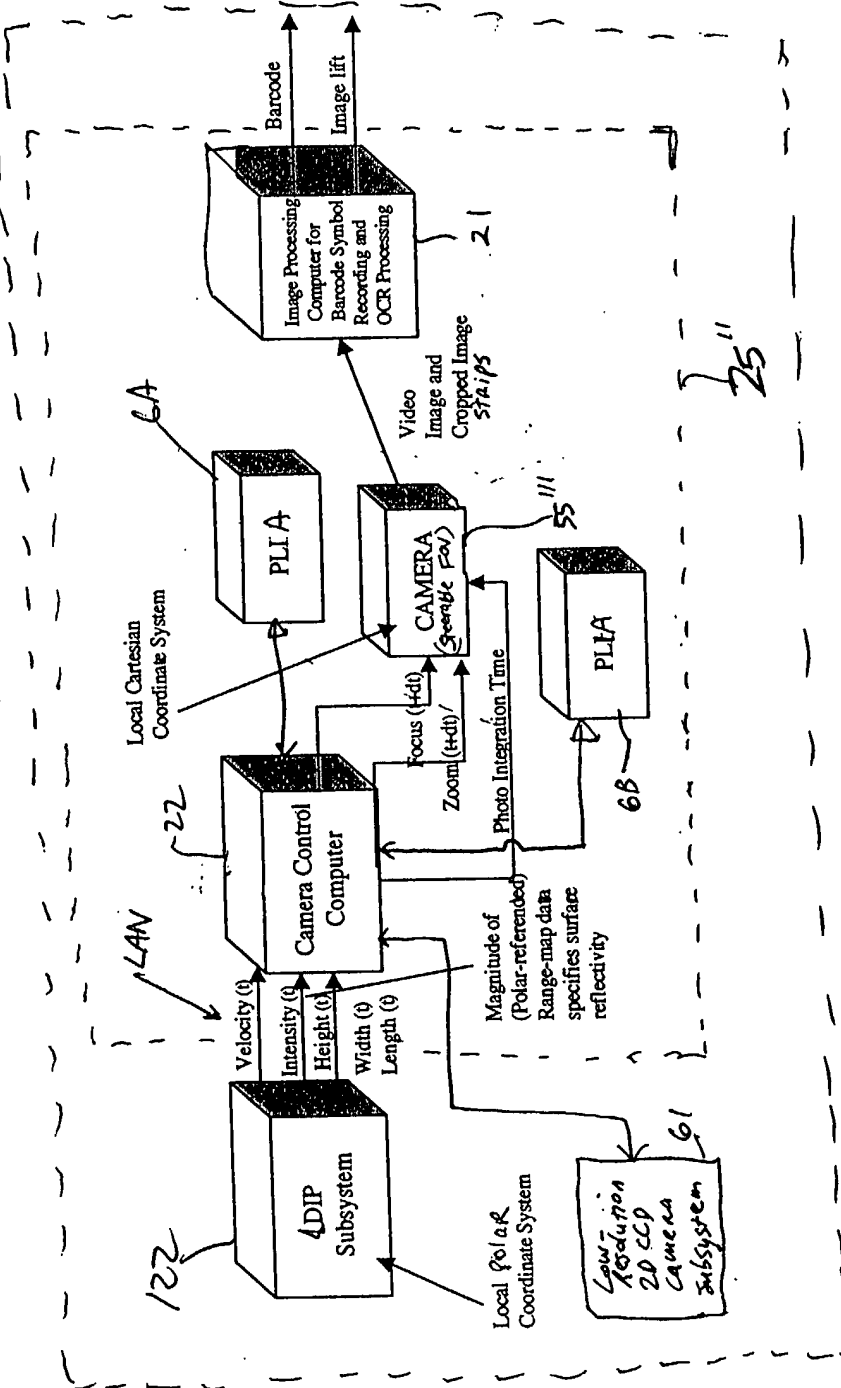
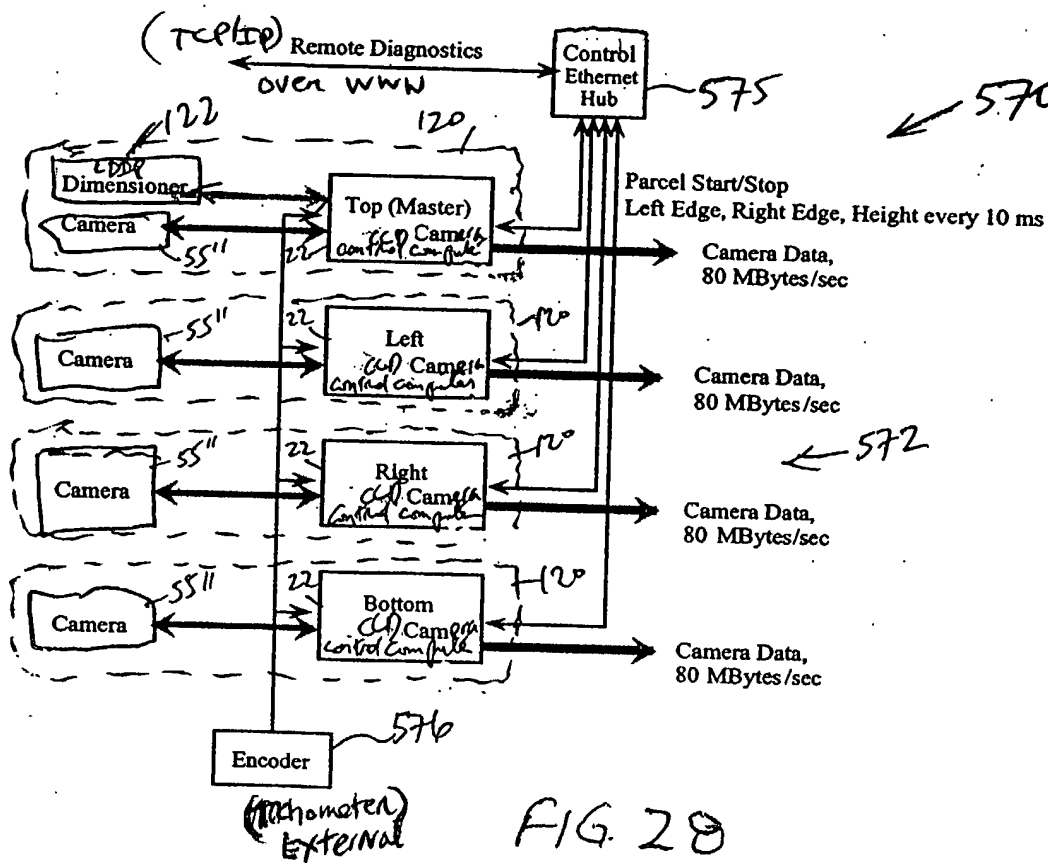
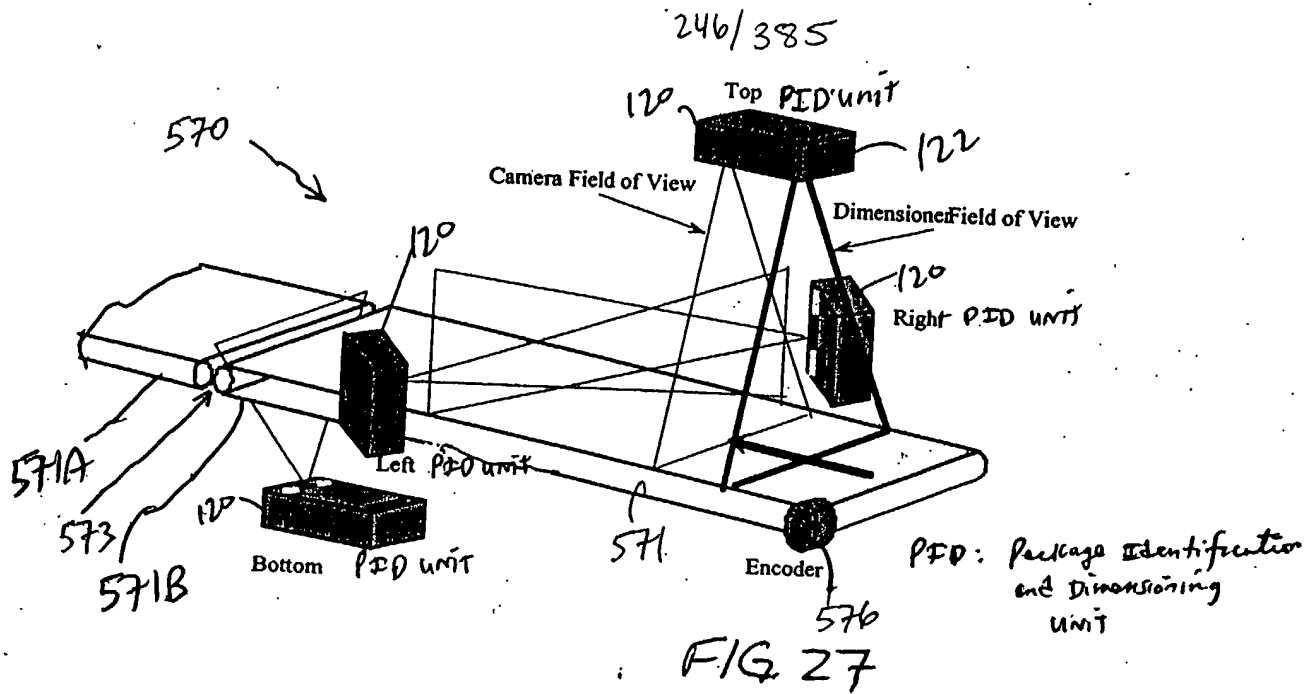


FIG. 26

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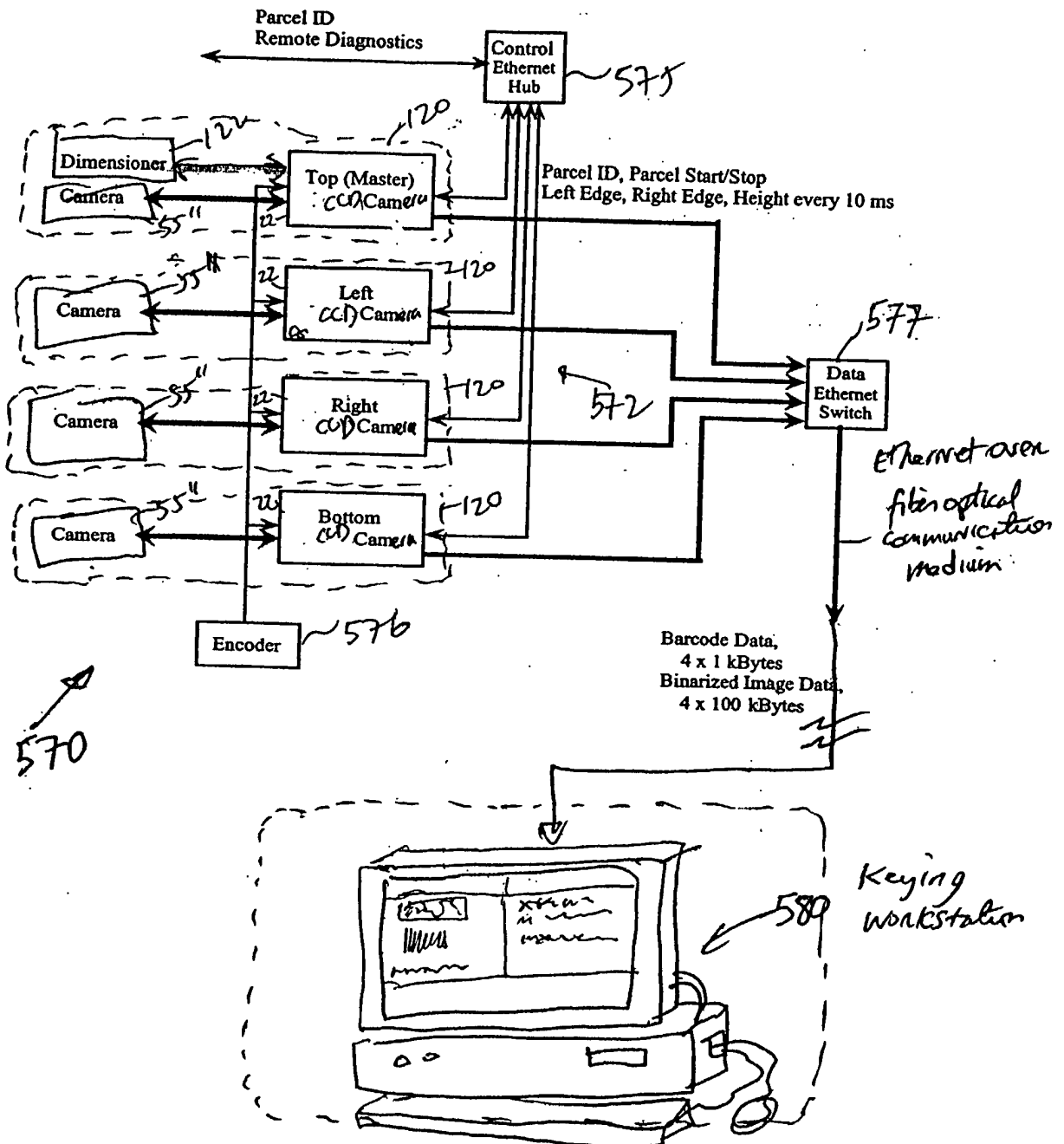


FIG. 29

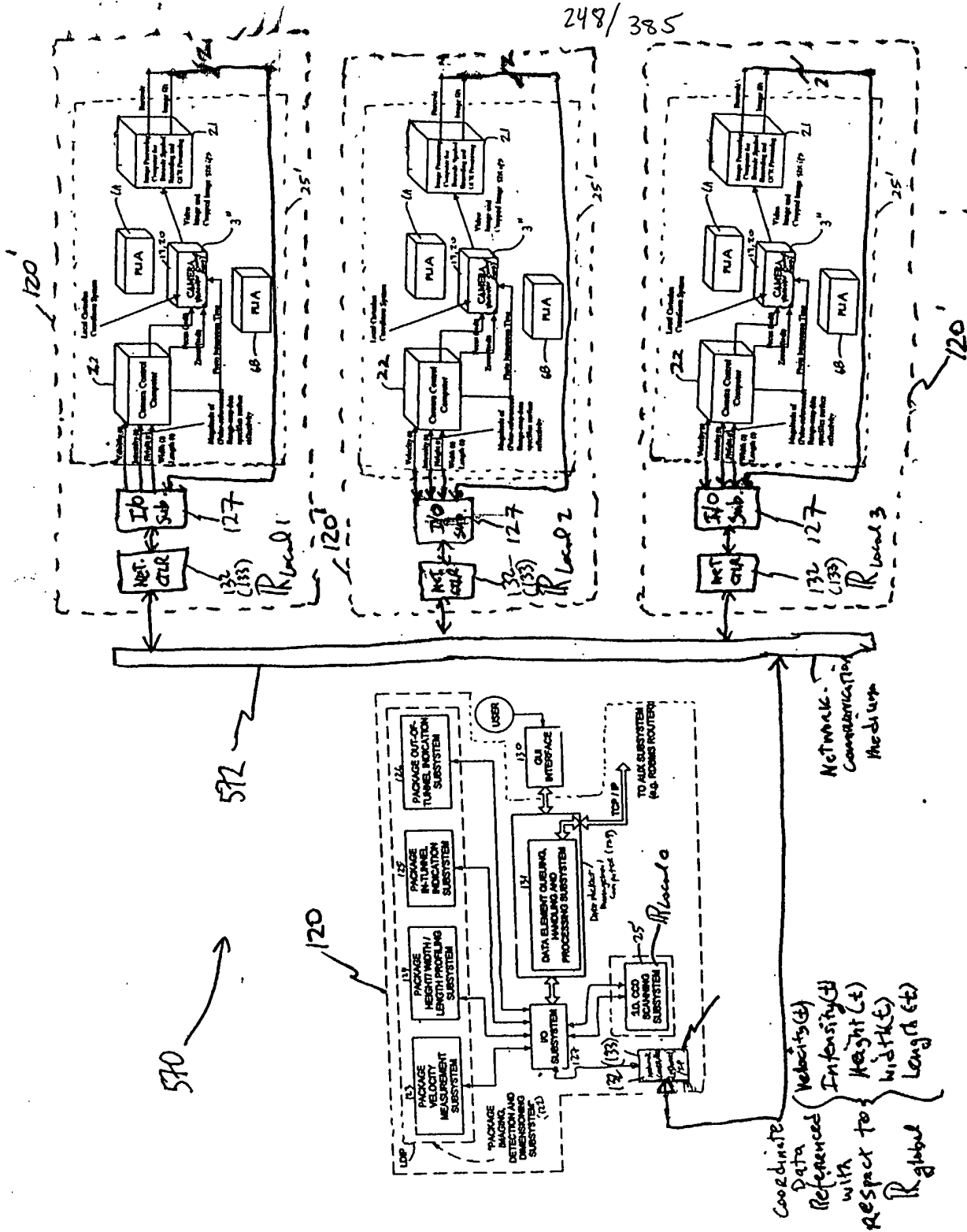
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FIG 30

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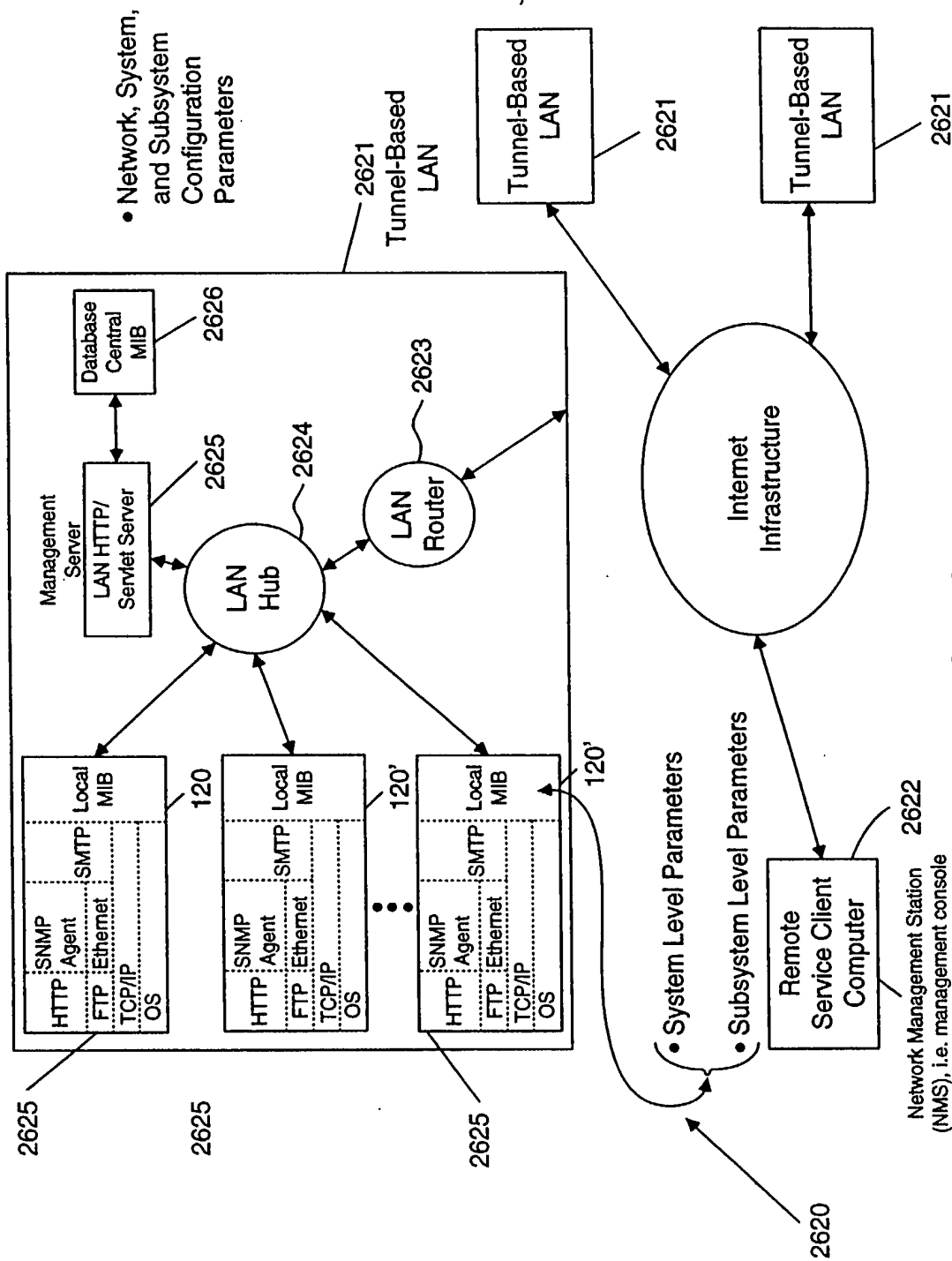


FIG. 30A

• Network, System, and Subsystem Configuration Parameters

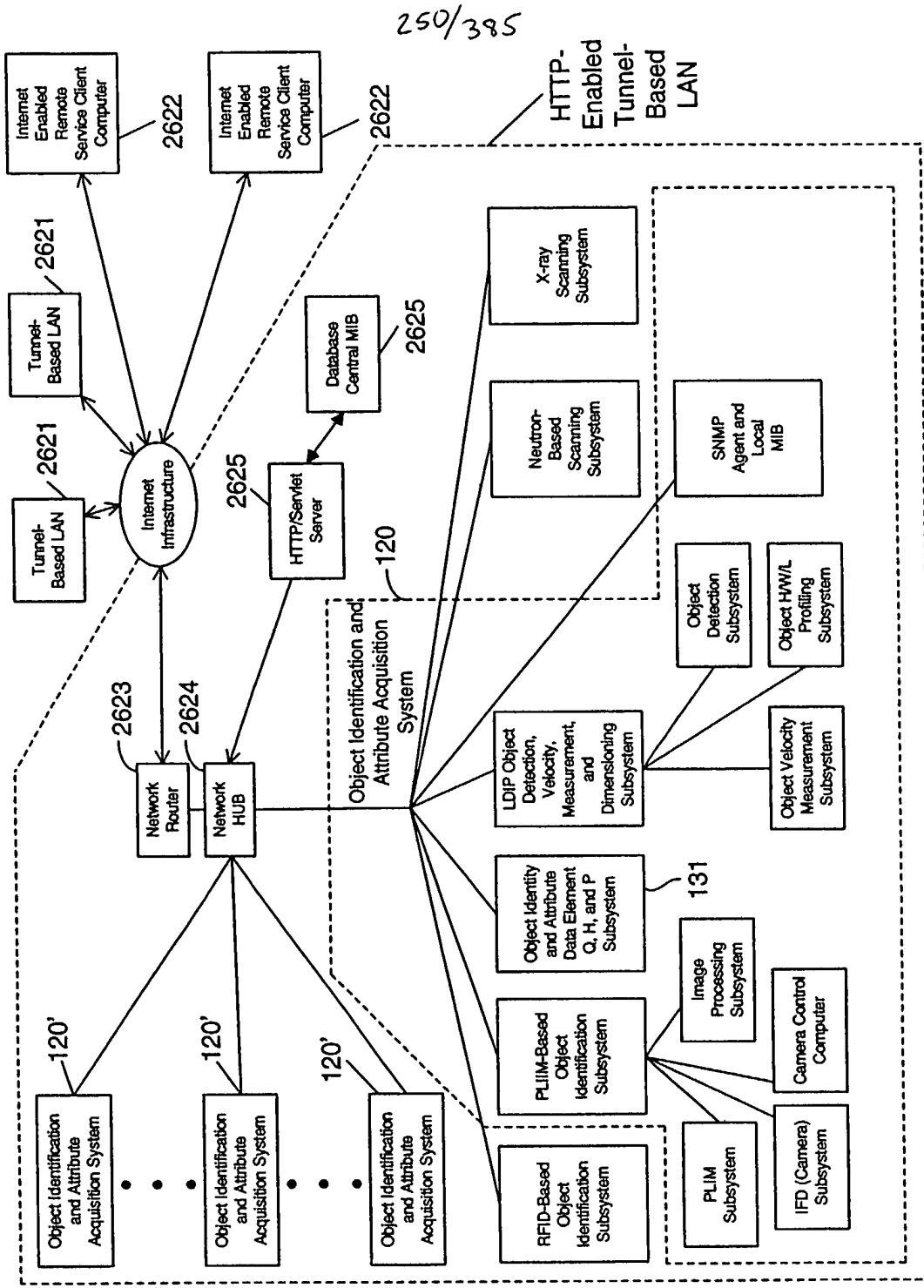


FIG. 30B

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Network Configuration Parameters:

[Router IP address; no. of nodes (i.e. systems) in LAN; passwords, LAN location; name of customer facility; technical contact; phone no.; domain name; object identity codes; object attribute acquisition codes;.....]

System Configuration Parameters:

[System IP Address; passwords; object identity codes; object attribute acquisition codes;.....]

Monitorable and/or Configurable Parameters for Subsystems Within Each System:

- | | |
|--|---|
| <p>These subsystems generate object identity parameters</p> | <p><input type="checkbox"/> PLIM-based object identification subsystem: [object identity code; object attribute acquisition codes;.....]</p> <p><input type="checkbox"/> PLIM Subsystem: [VLD status; power VLD; TIM function; temp;.....]</p> <p><input type="checkbox"/> IFD (Camera) Subsystem: [sensor temp;]</p> <p><input type="checkbox"/> Image Processing Subsystem (Computer): [processor load history; system up time; # of frames (pgs); barcode read rate; current line rate;.....]</p> <p><input type="checkbox"/> Camera Contact Subsystem (Computer): [number of frames dropped; number of focused zoom commands; number and kinds of motor control errors;.....]</p> |
| <p>This system links object attribute data element parameters (i.e. object identity data element) to corresponding object identity parameters (i.e. object attribute data element)</p> | <p><input type="checkbox"/> RFID-based object identification subsystem: [.....]</p> <p><input type="checkbox"/> Object identity and attribute data element queuing, handling and processing subsystem: [.....]</p> |
| <p>These subsystems generate object attribute parameters</p> | <p><input type="checkbox"/> LDIP object identification, velocity-measurement, and dimensioning subsystem: [.....]</p> <p><input type="checkbox"/> Object velocity measurement subsystem: [polygon RPM; polygon laser output X; channel X drift; channel X noise; trigger error events; instant lock reference drift; temperature]</p> <p><input type="checkbox"/> Object H/W/L profiling subsystem</p> <p><input type="checkbox"/> Object detection subsystem: [non- singulation/ singulation code;.....]</p> <p><input type="checkbox"/> X-ray scanning subsystem: [.....]</p> <p><input type="checkbox"/> Neutron-beam scanning subsystem: [.....]</p> |

FIG. 30C

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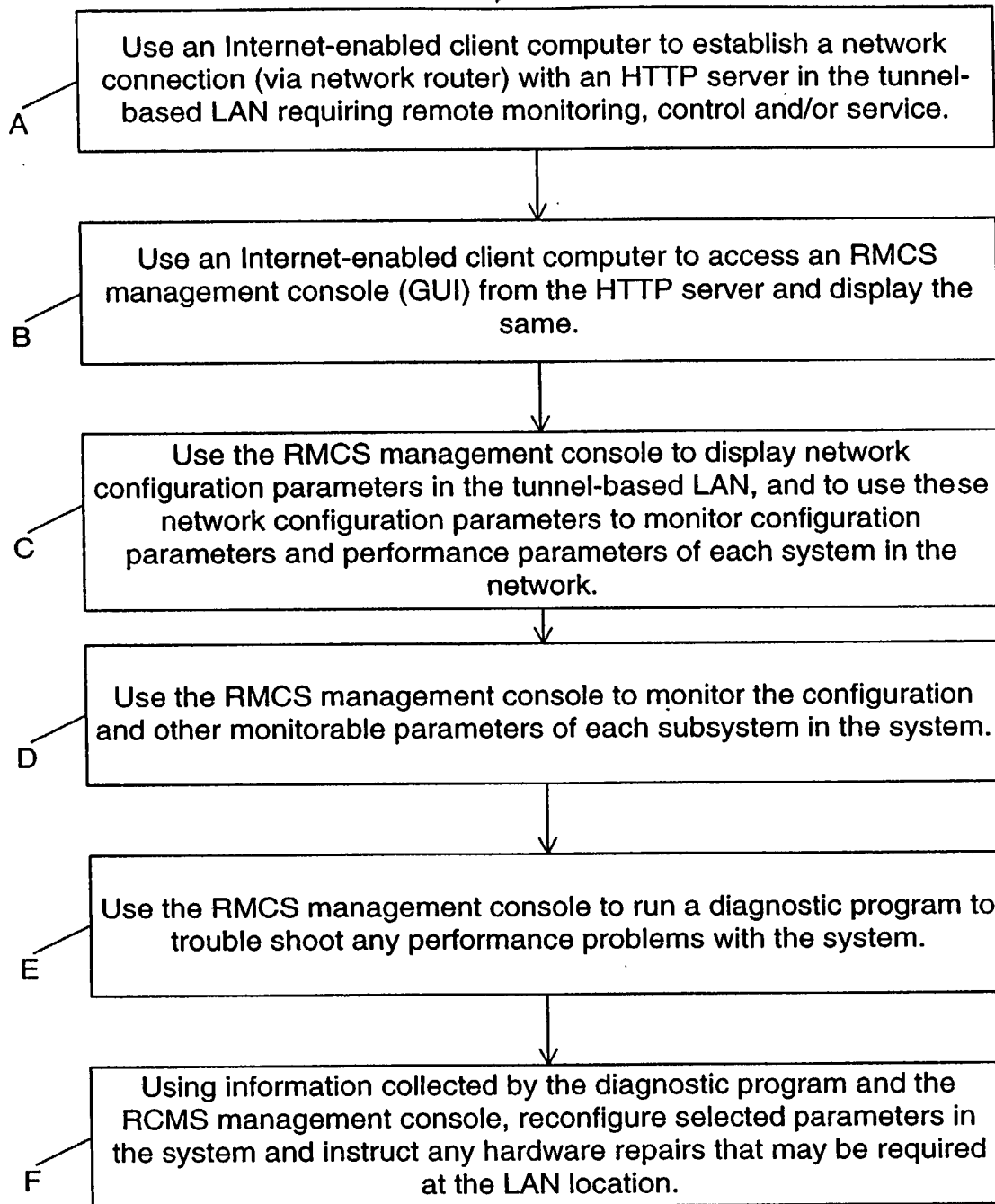


FIG. 30D1

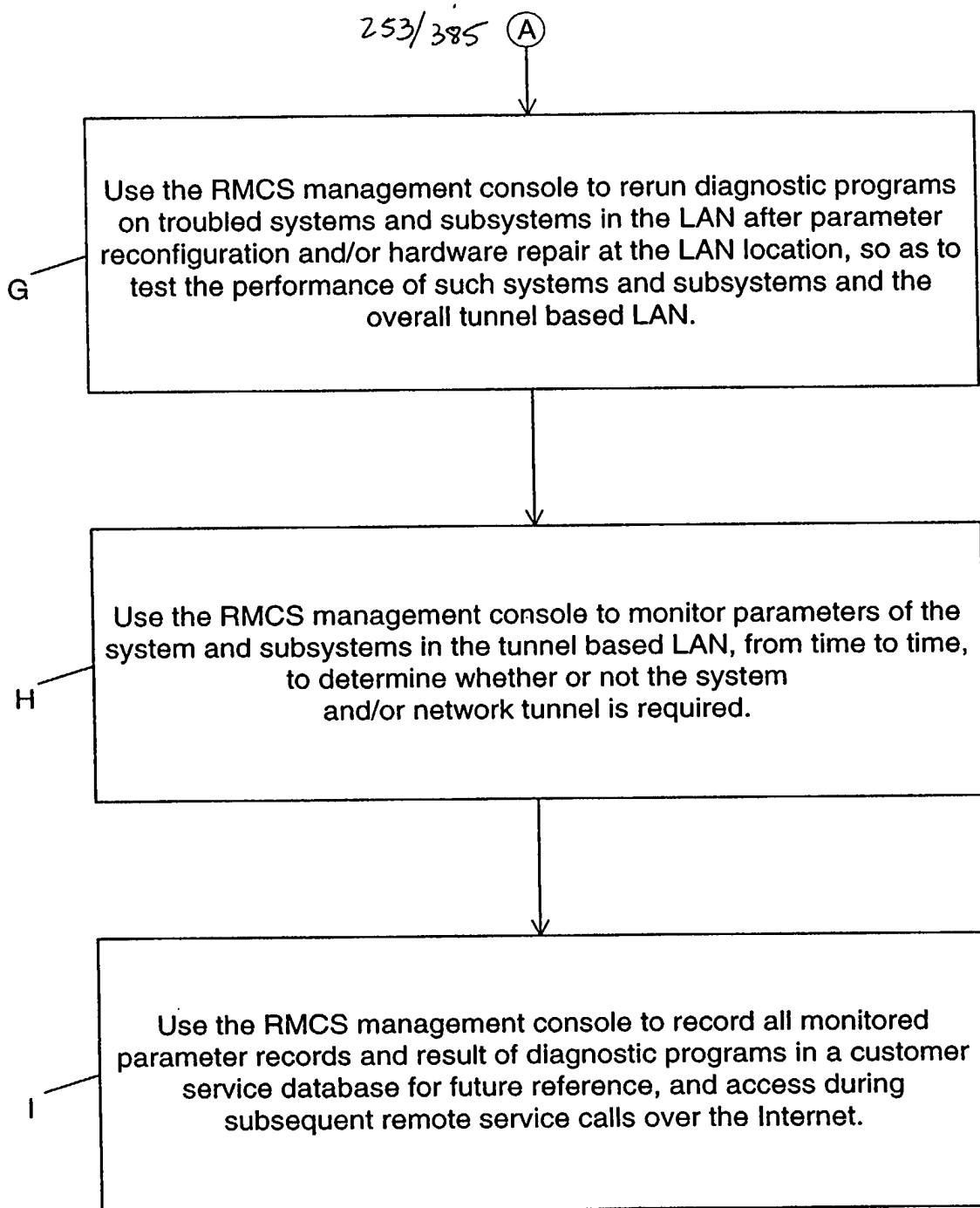


FIG. 30D2

CCD Camera-Based Tunnel System
Employing Package Coordinate Data
Driven Method of Automatic Camera
Zoom and Focus Control

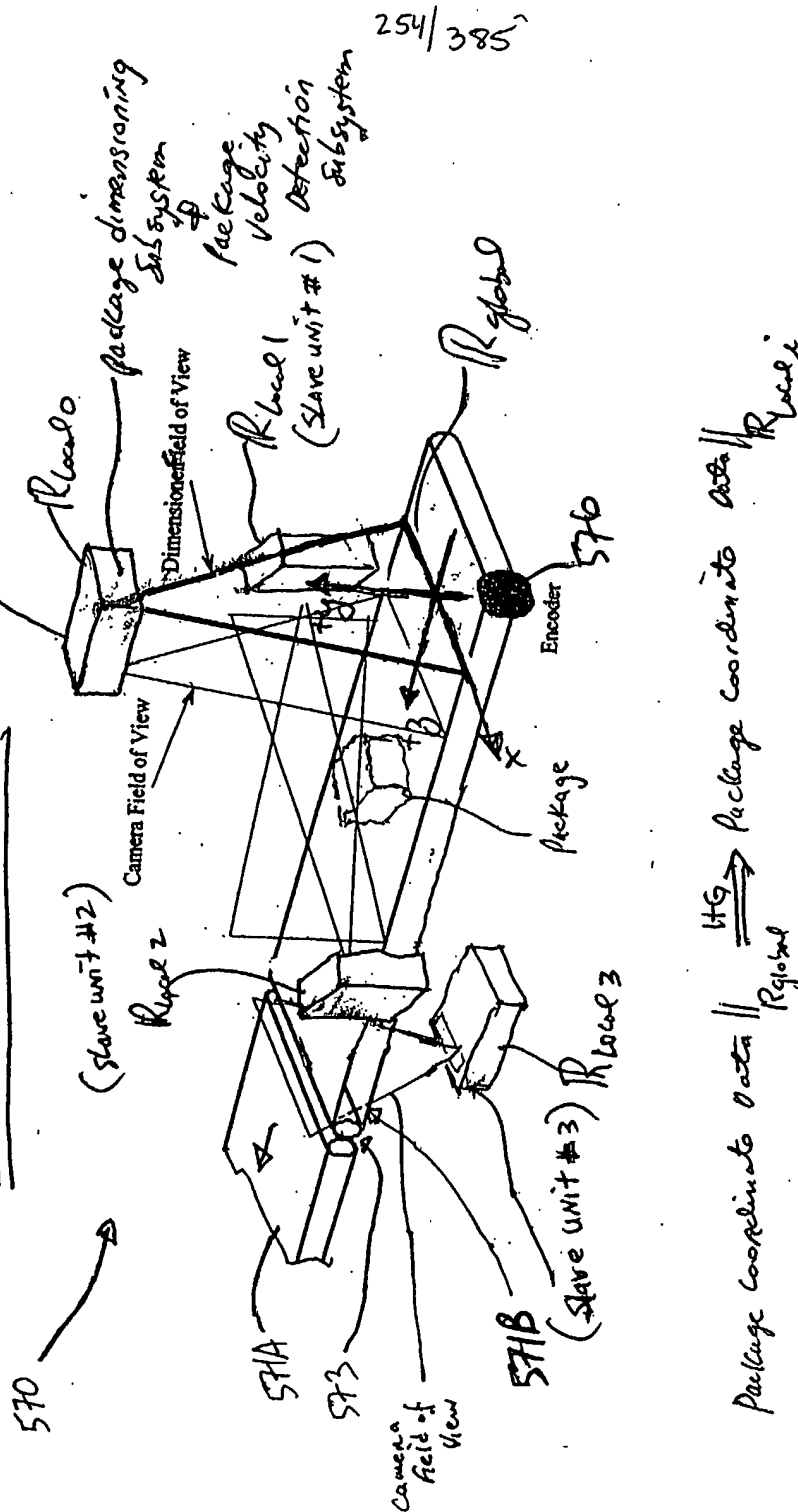


FIG. 31

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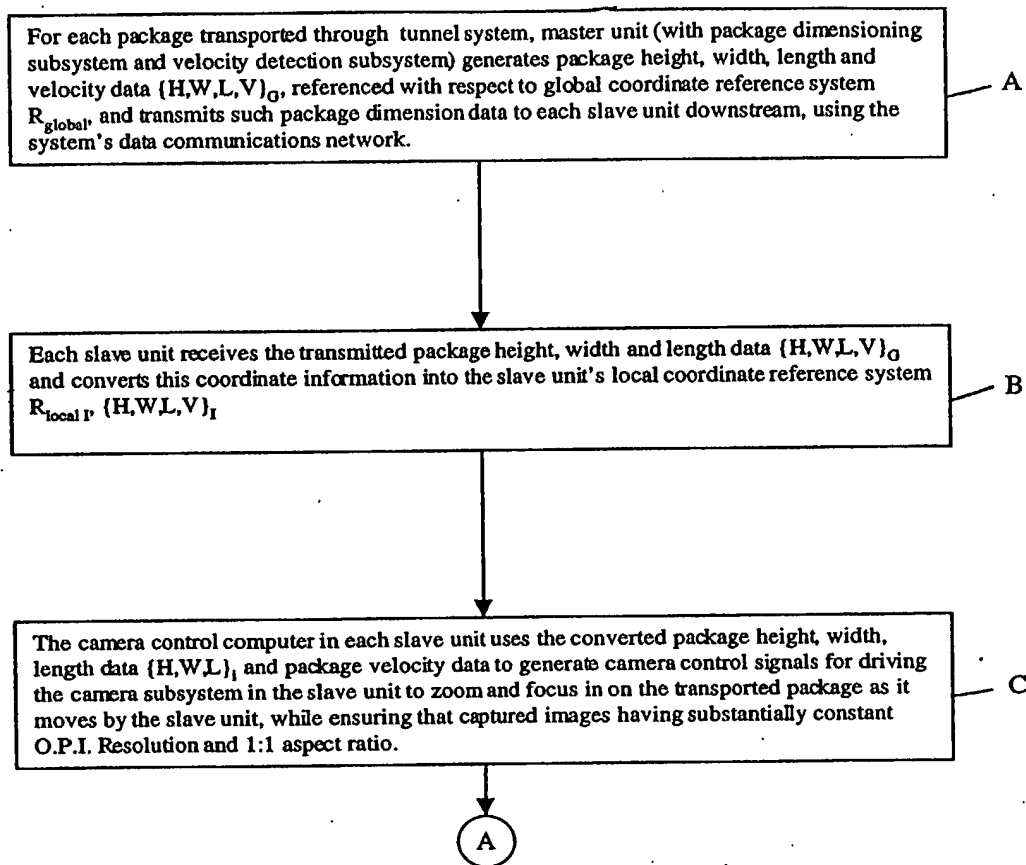


FIG. 32A

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A

Each slave unit captures images acquired by its intelligently controlled camera subsystem, buffers the same, and processes the images to decode bar code symbol identifiers represented in said images, and/or to perform optical character recognition (OCR) thereupon.

D

The slave unit which decodes a bar code symbol in a processed image automatically transmits a package identification data element (containing symbol character data representative of the decoded bar code symbol) to the master unit (or other designated system control unit employing data element management functionalities) for package data element processing.

E

Master unit time-stamps received package identification data element, places said data element in a data queue, and processes package identification data elements and time-stamped package dimension data elements in said queue to link each package identification data element with one said corresponding package dimension data element.

F

FIG. 32B

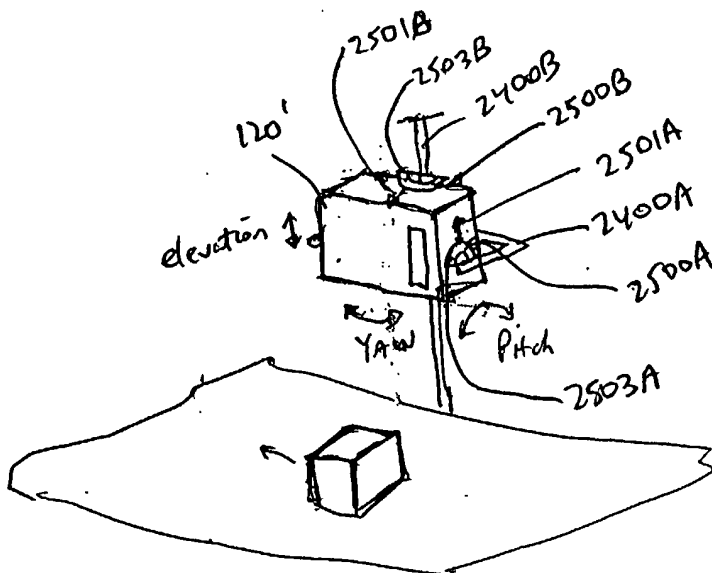
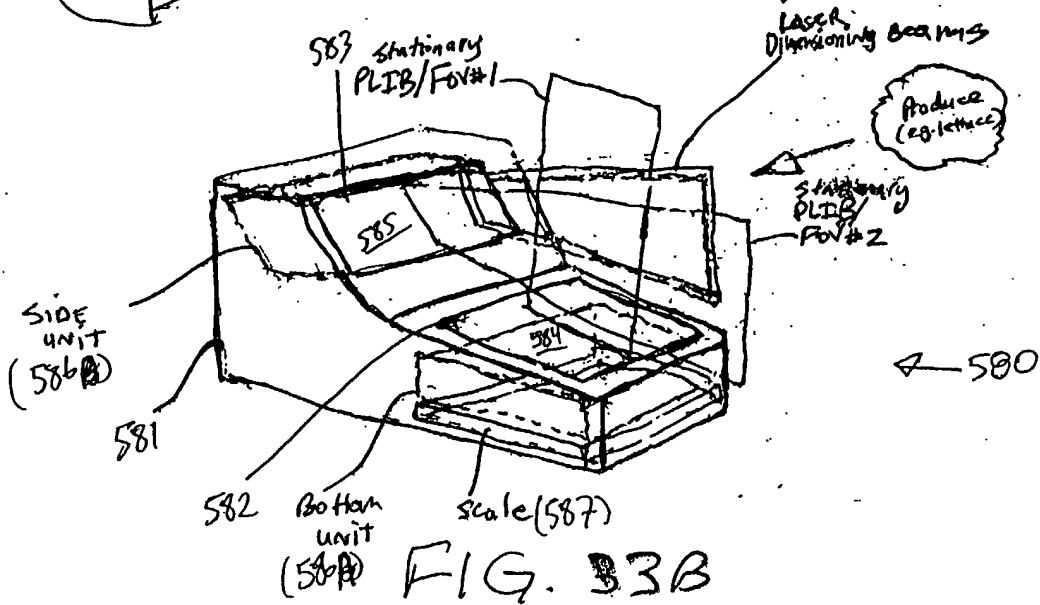
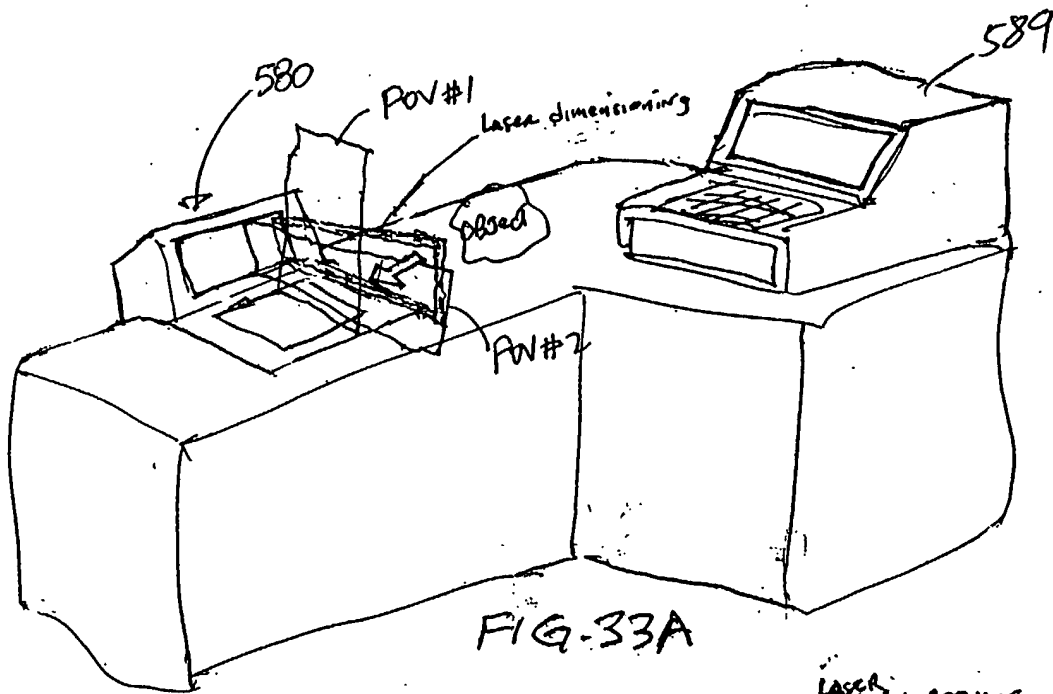
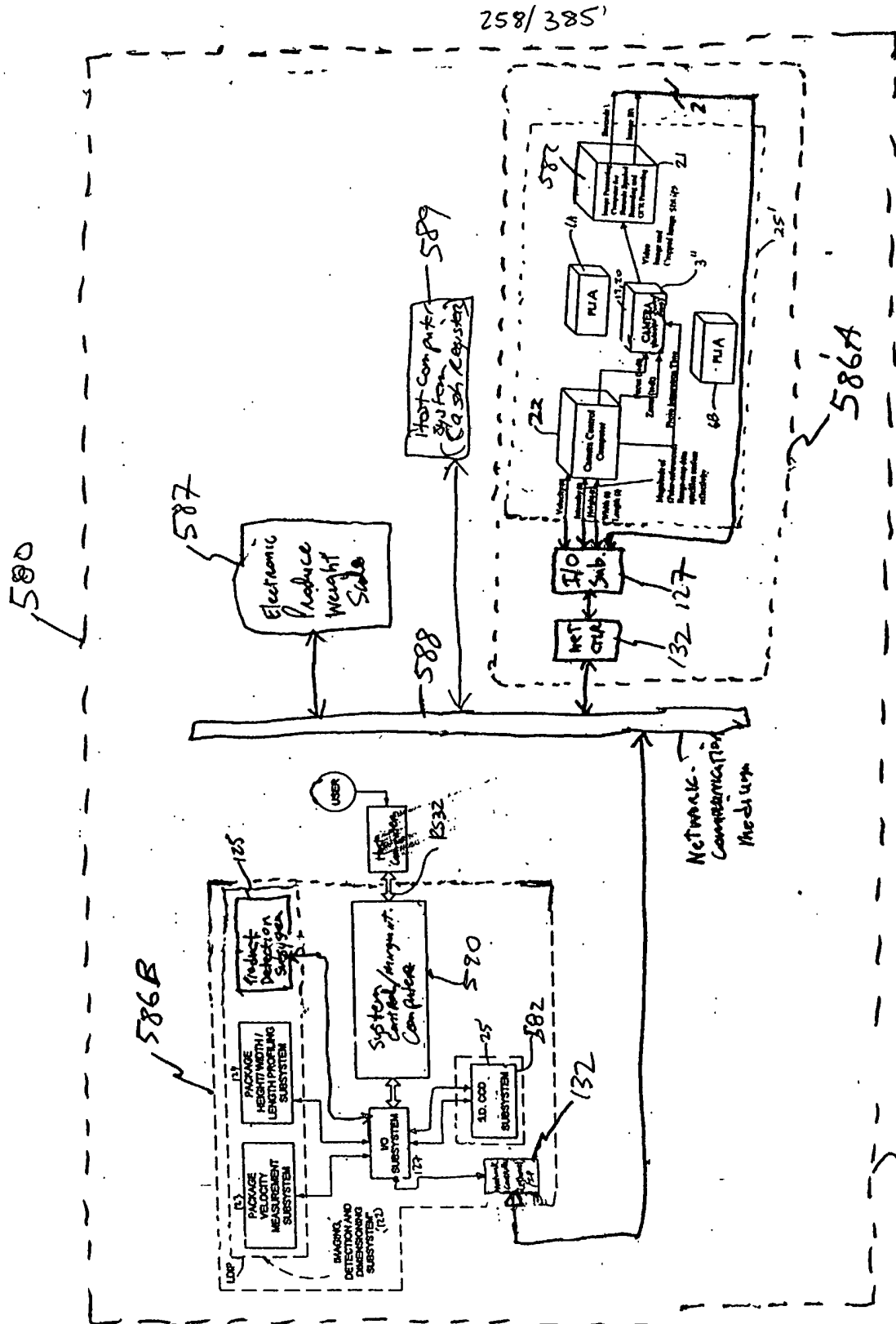


FIG. 31A

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F/G.33C

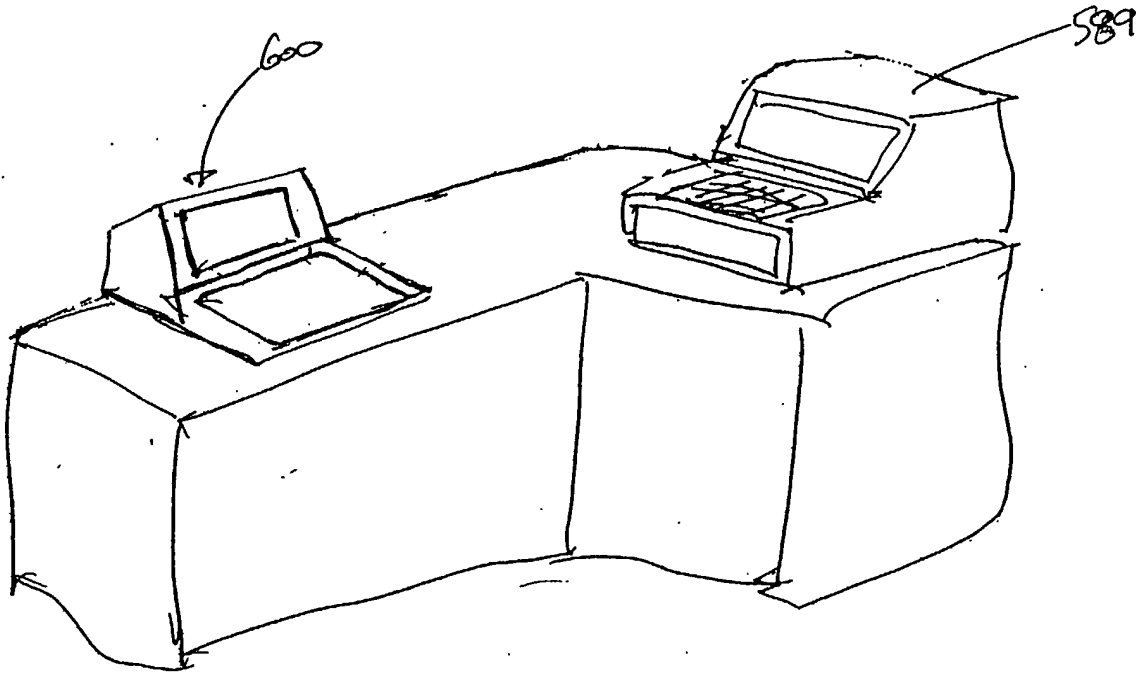
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FIG. 34A

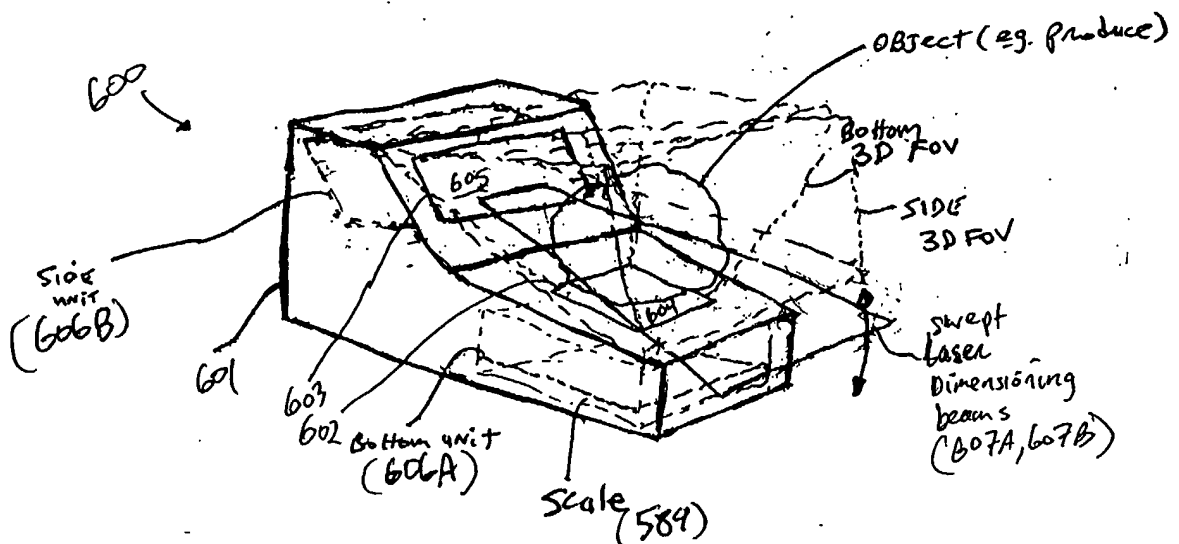
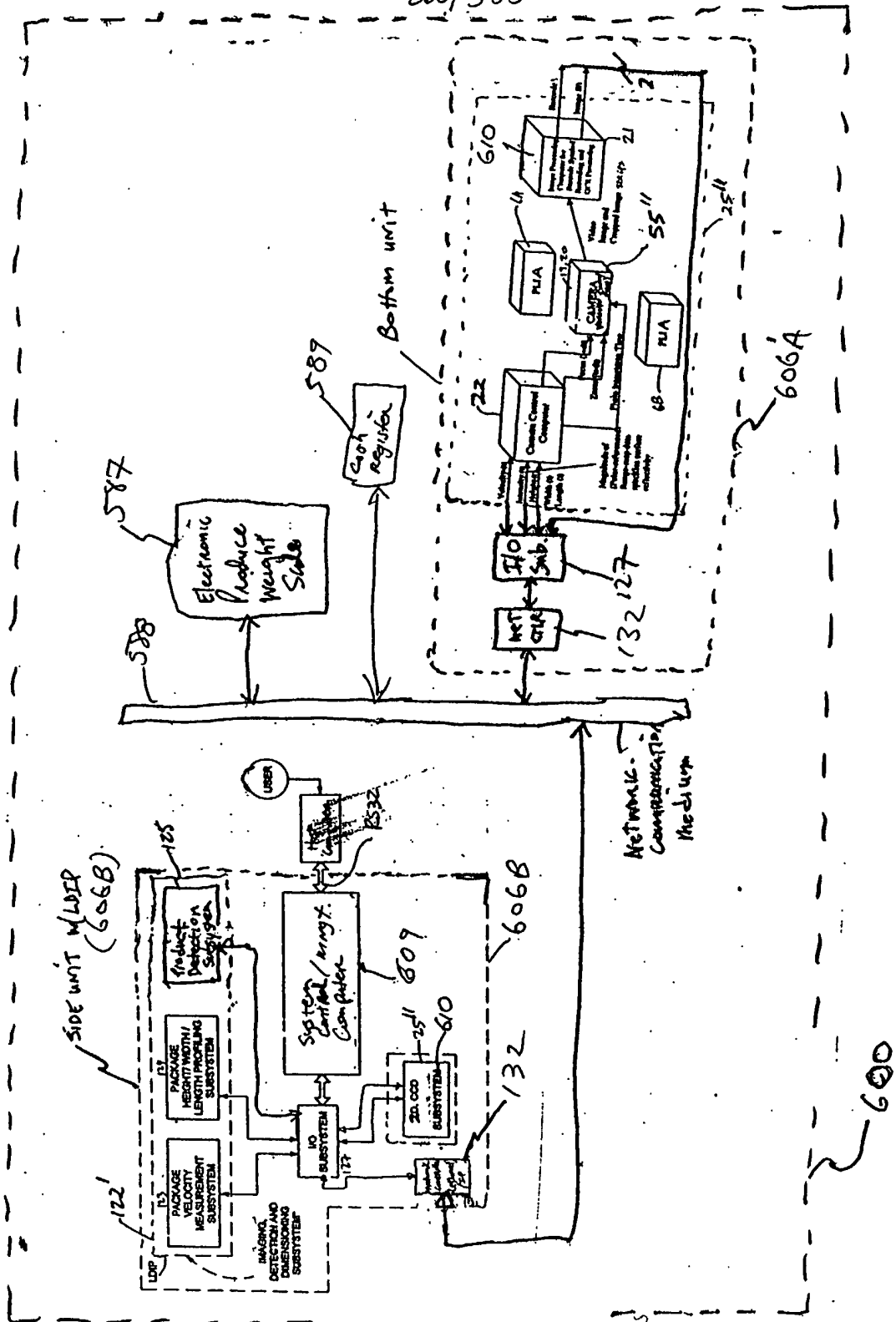


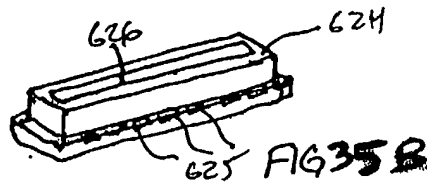
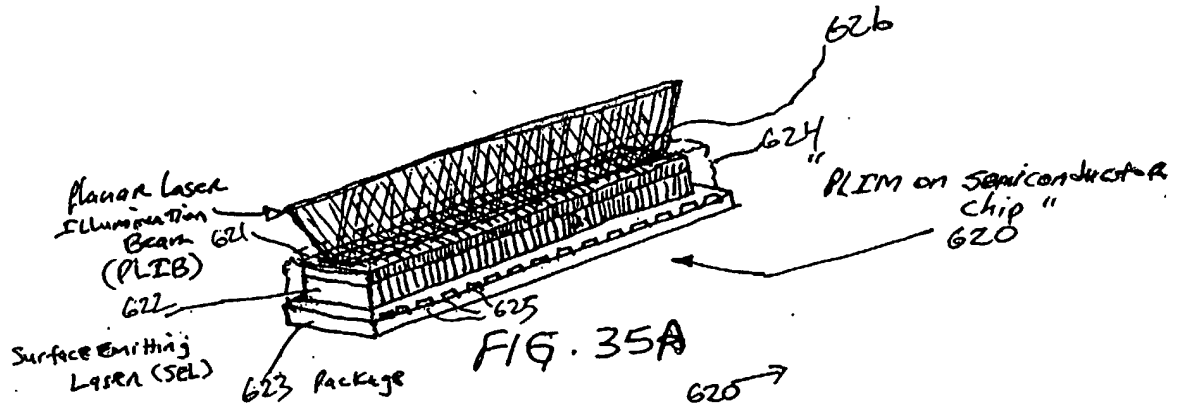
FIG. 34B

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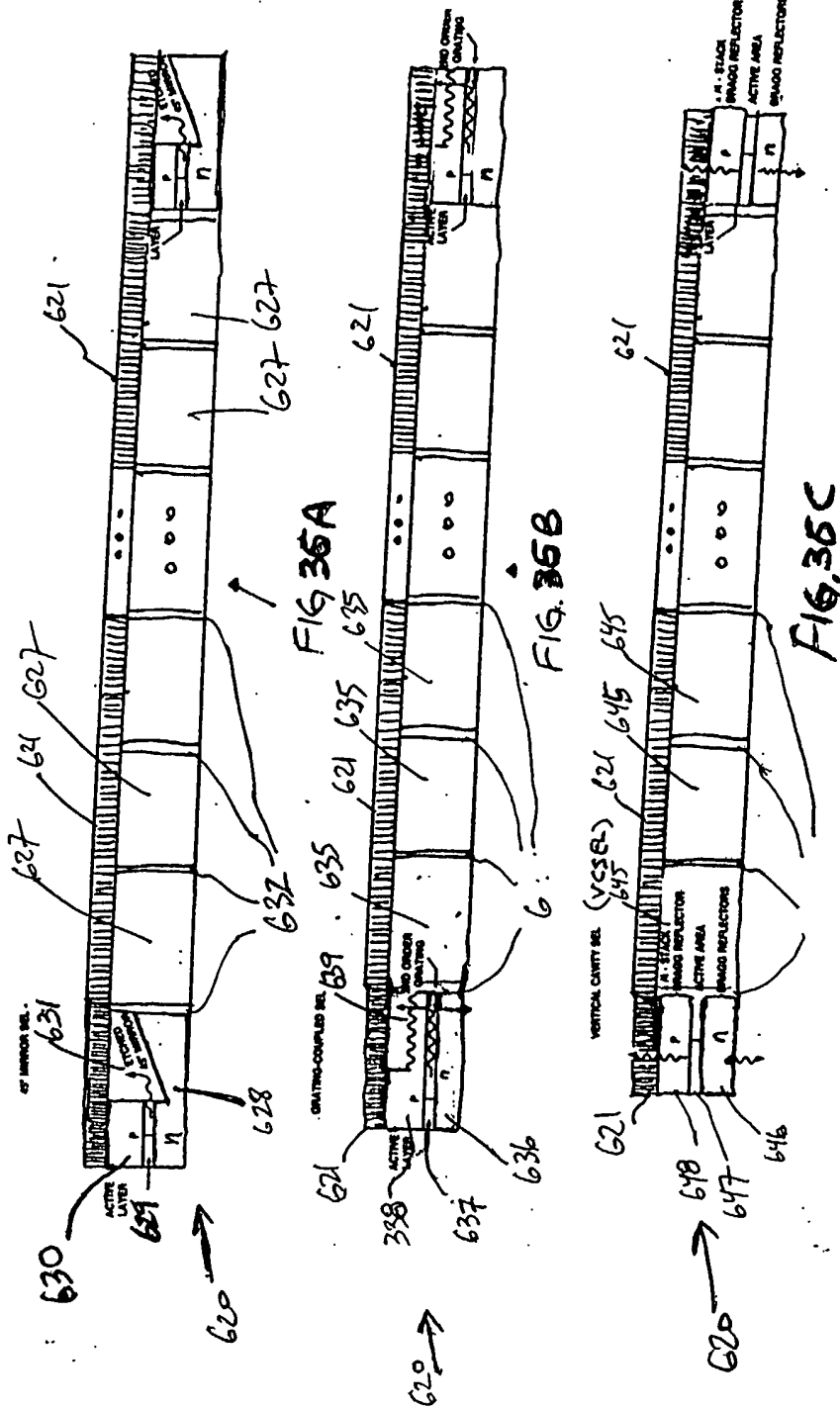


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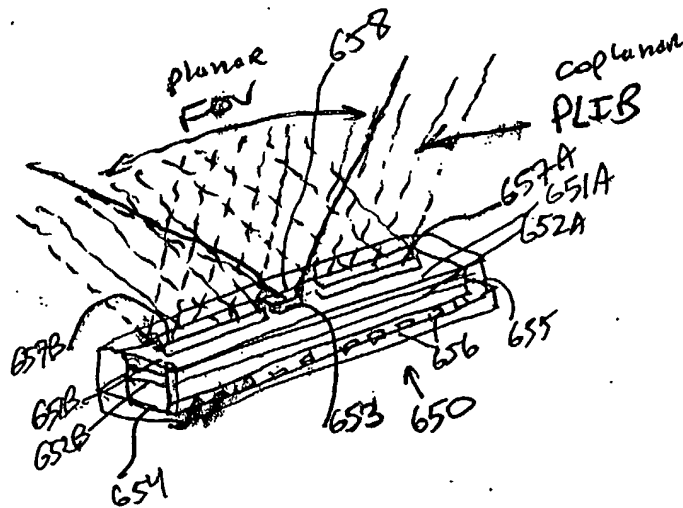


FIG. 37

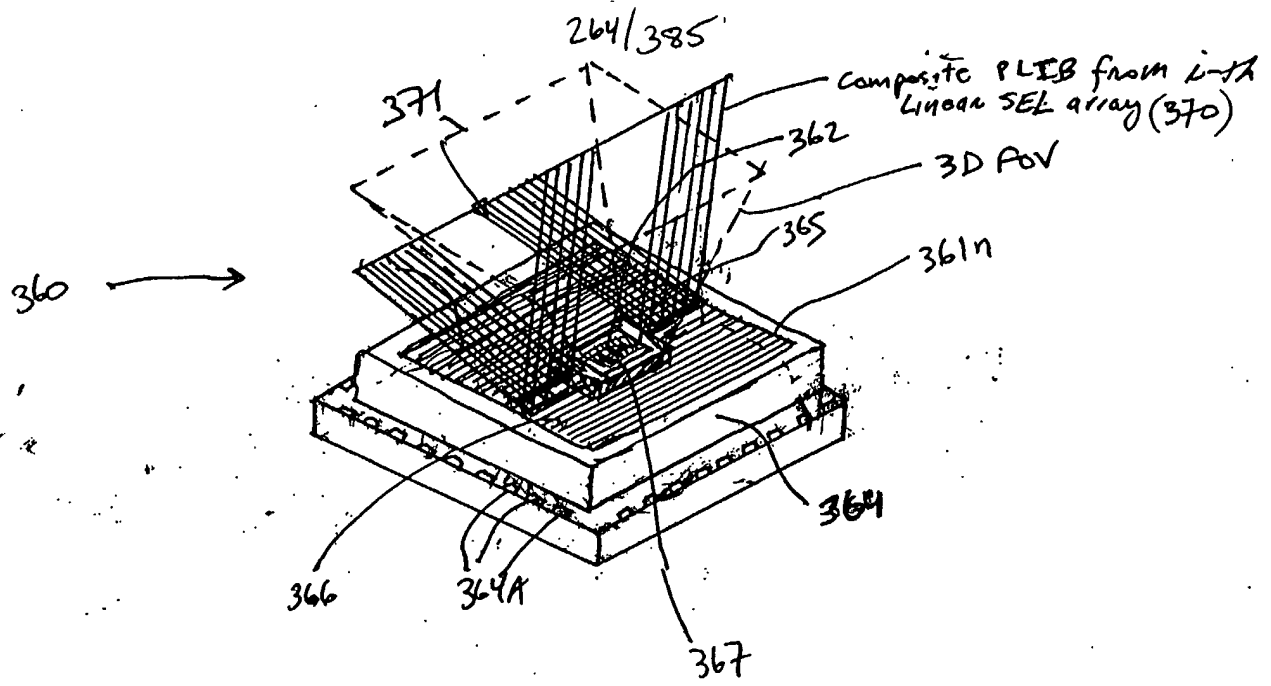


FIG. 38A

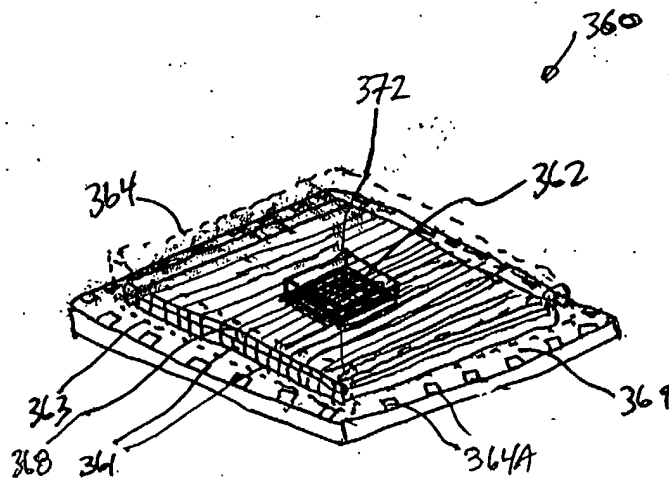


FIG. 38B

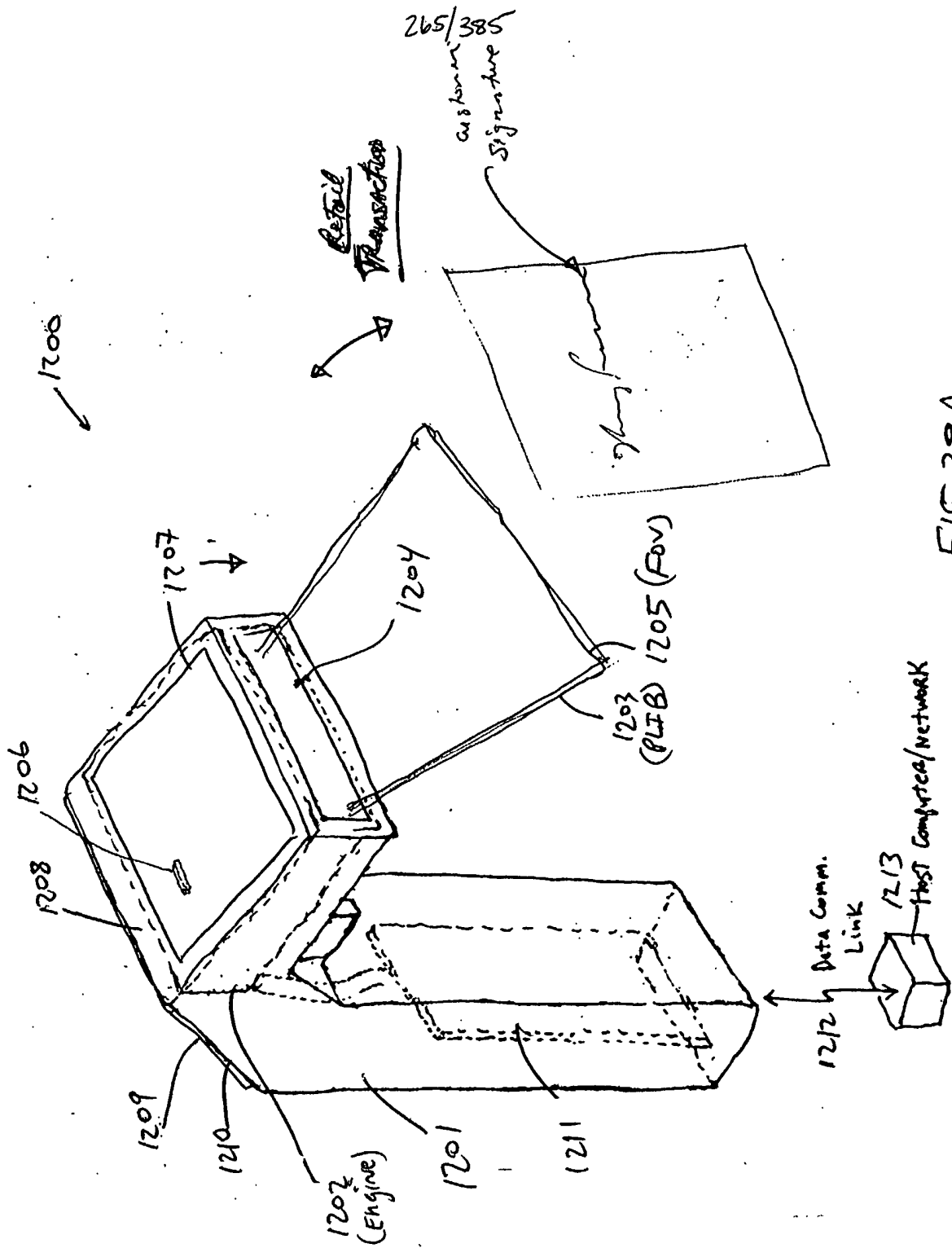


FIG. 39A

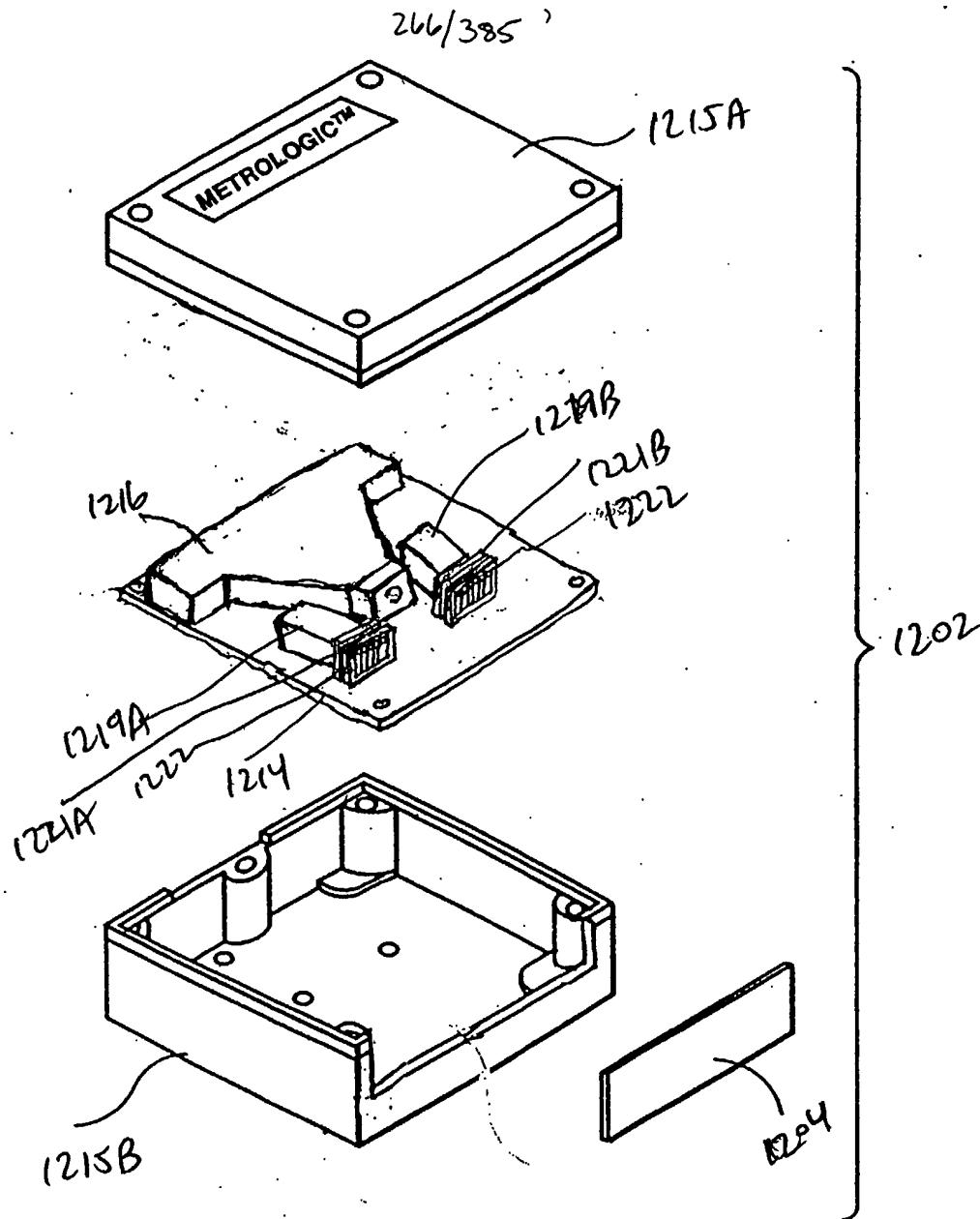


FIG. 39B

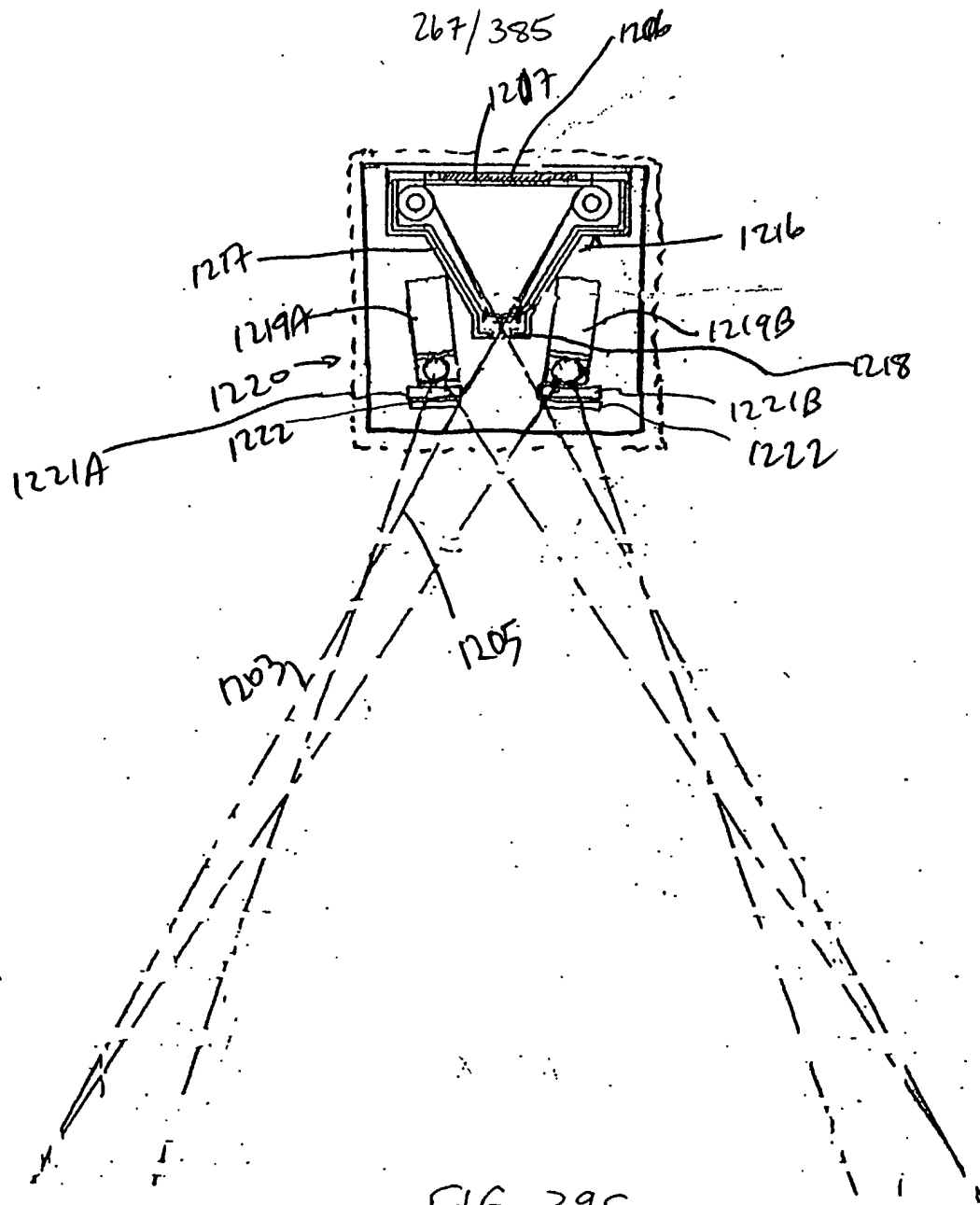


FIG. 39C

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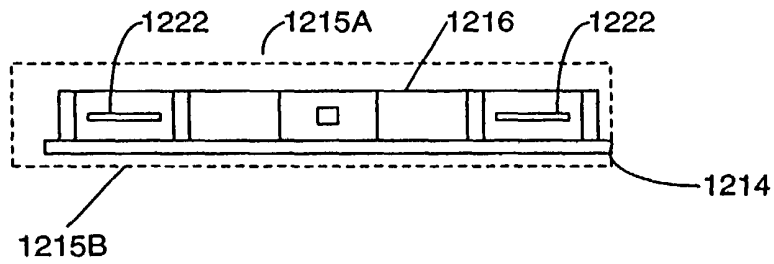


FIG. 39D

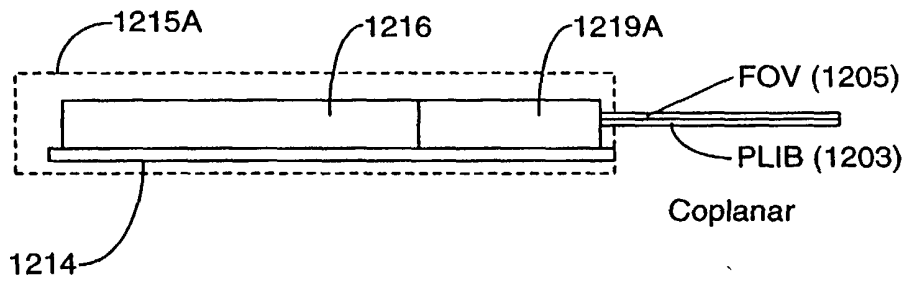


FIG. 39E

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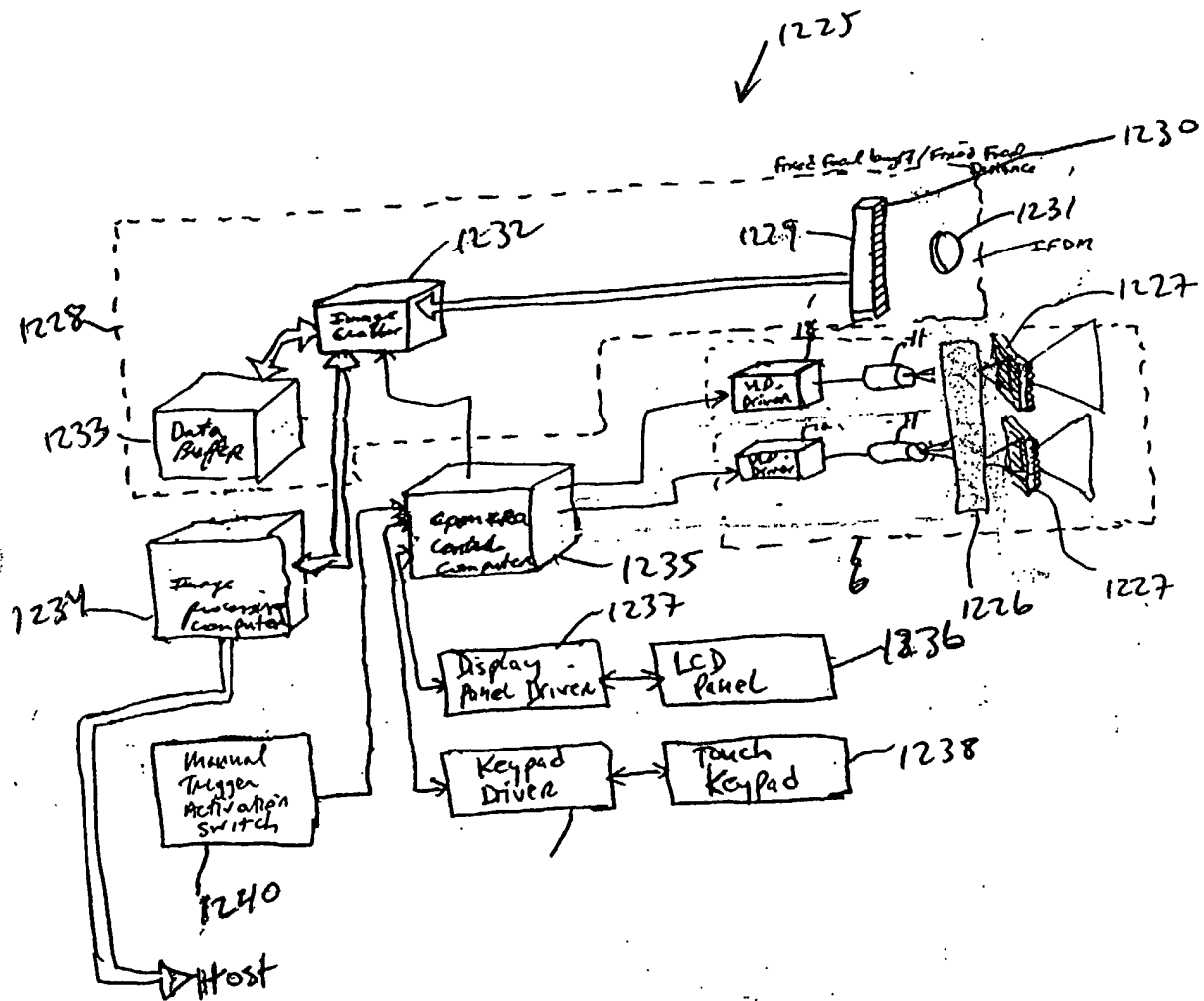
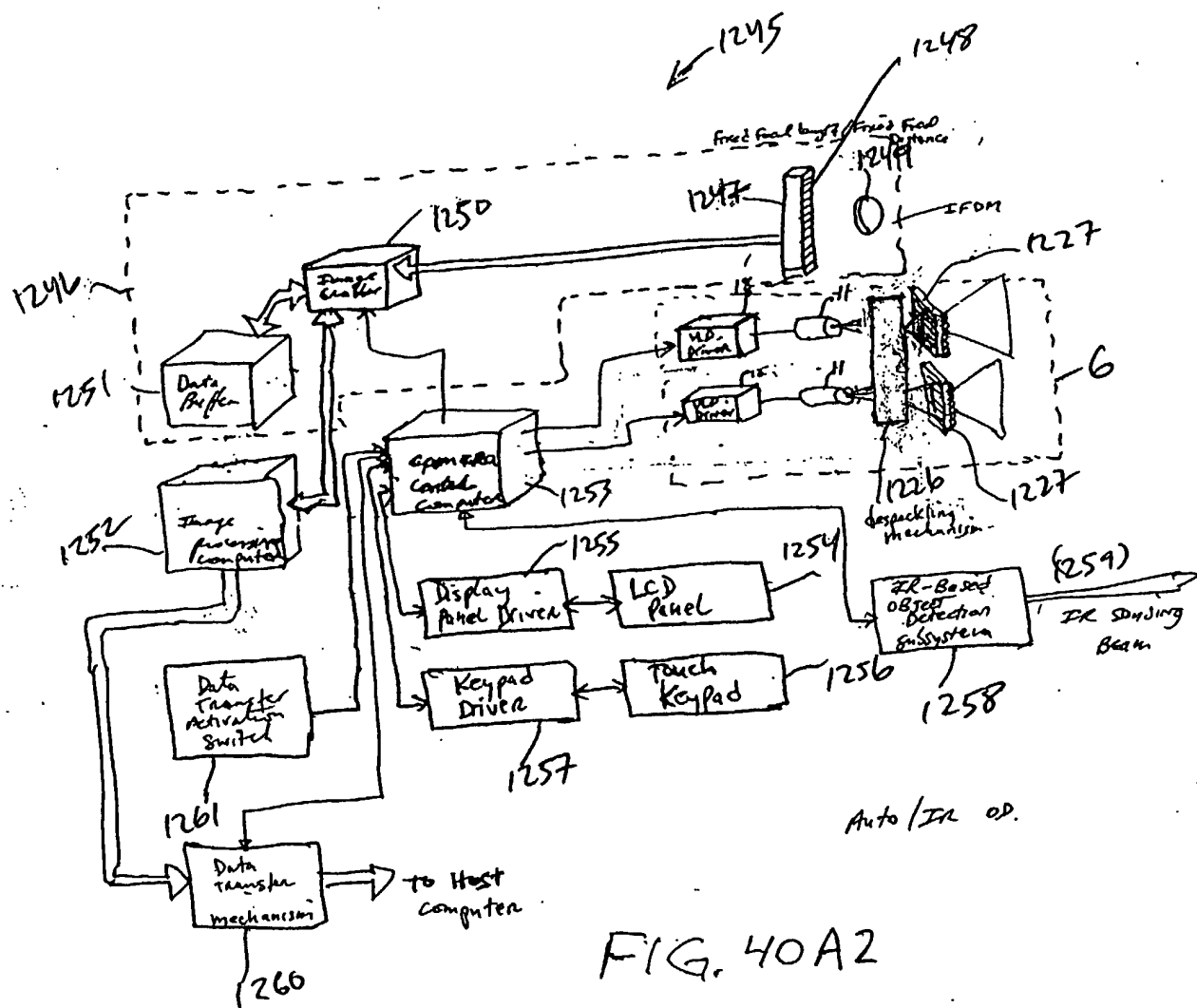
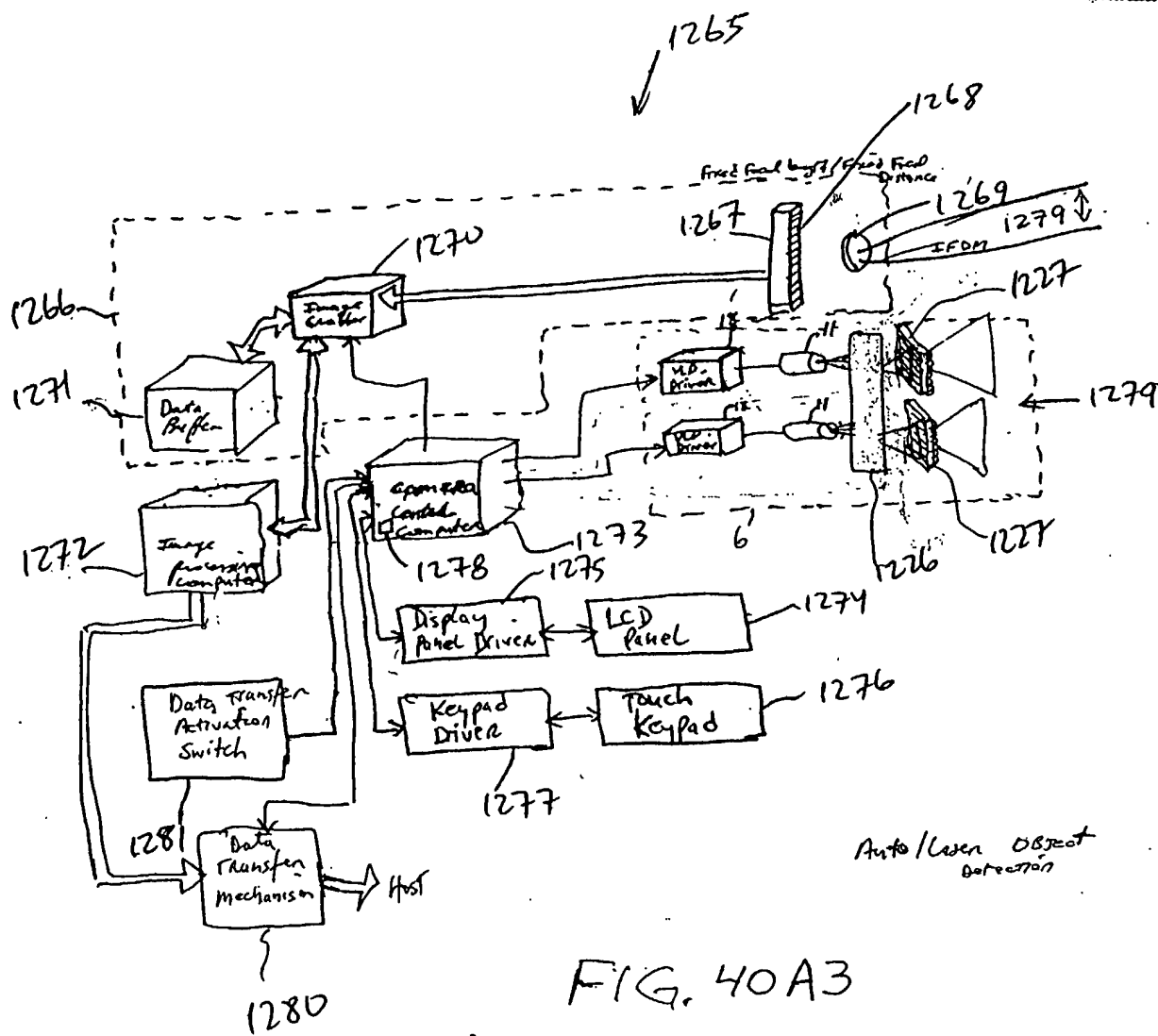


FIG. 40A1

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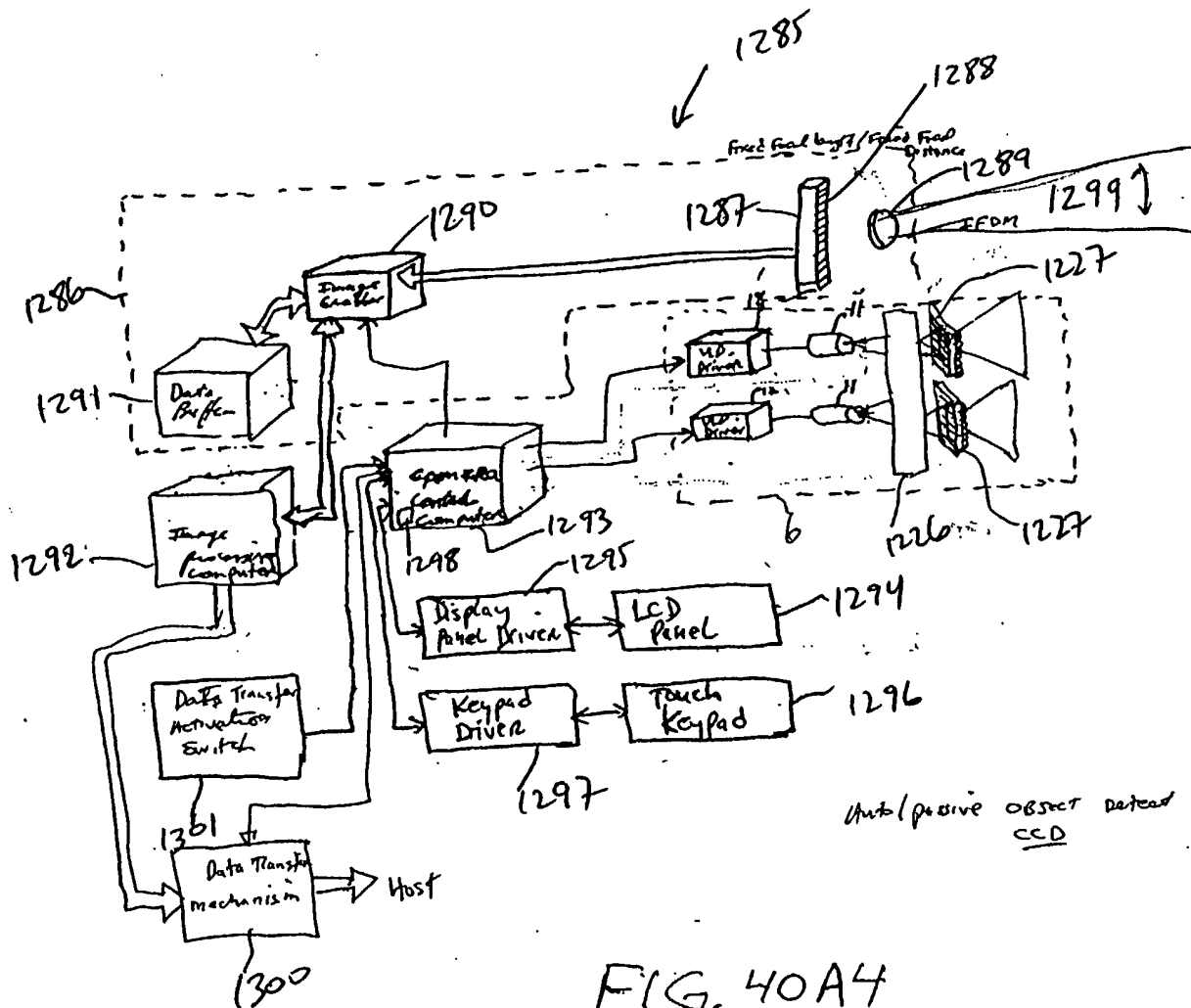


FIG. 40A4

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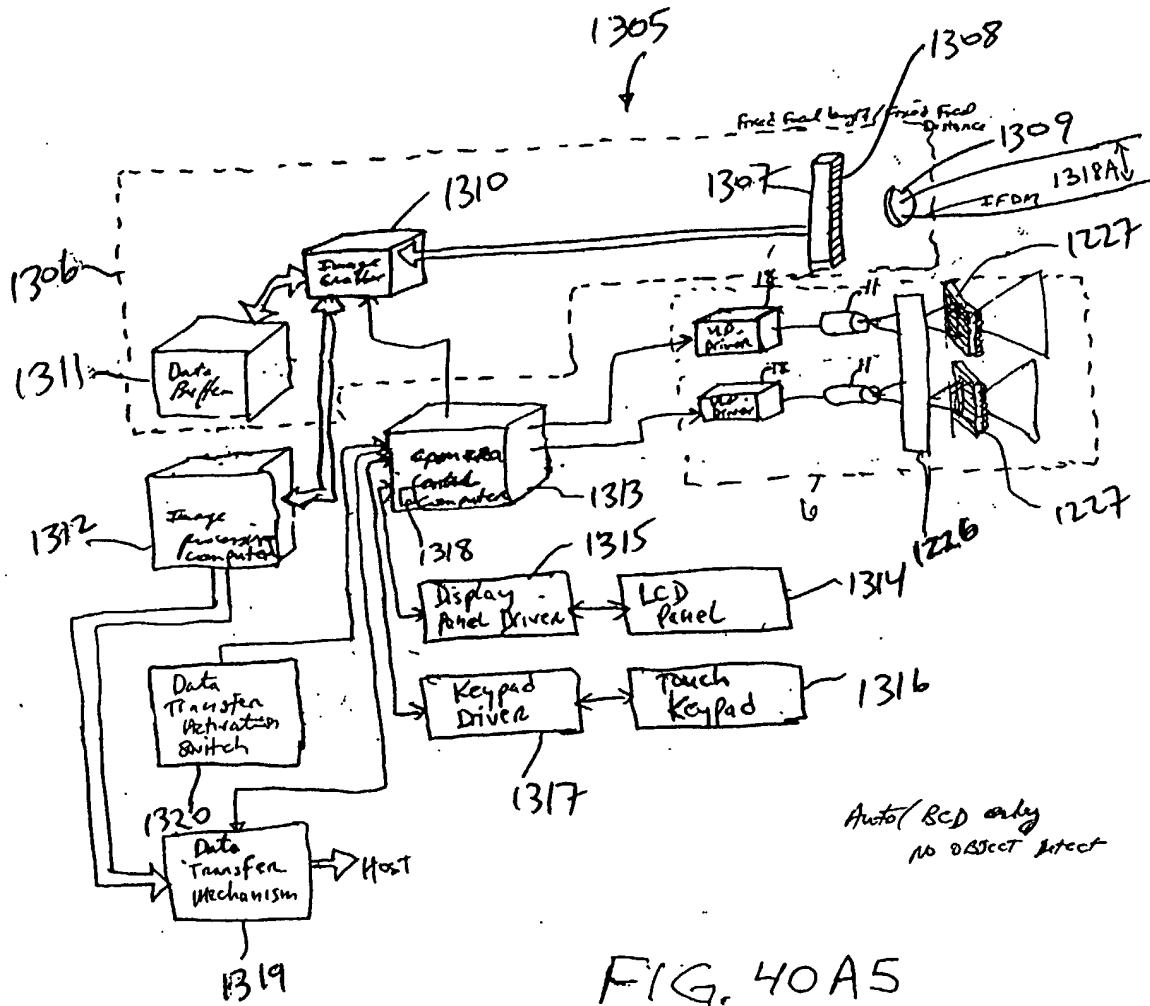
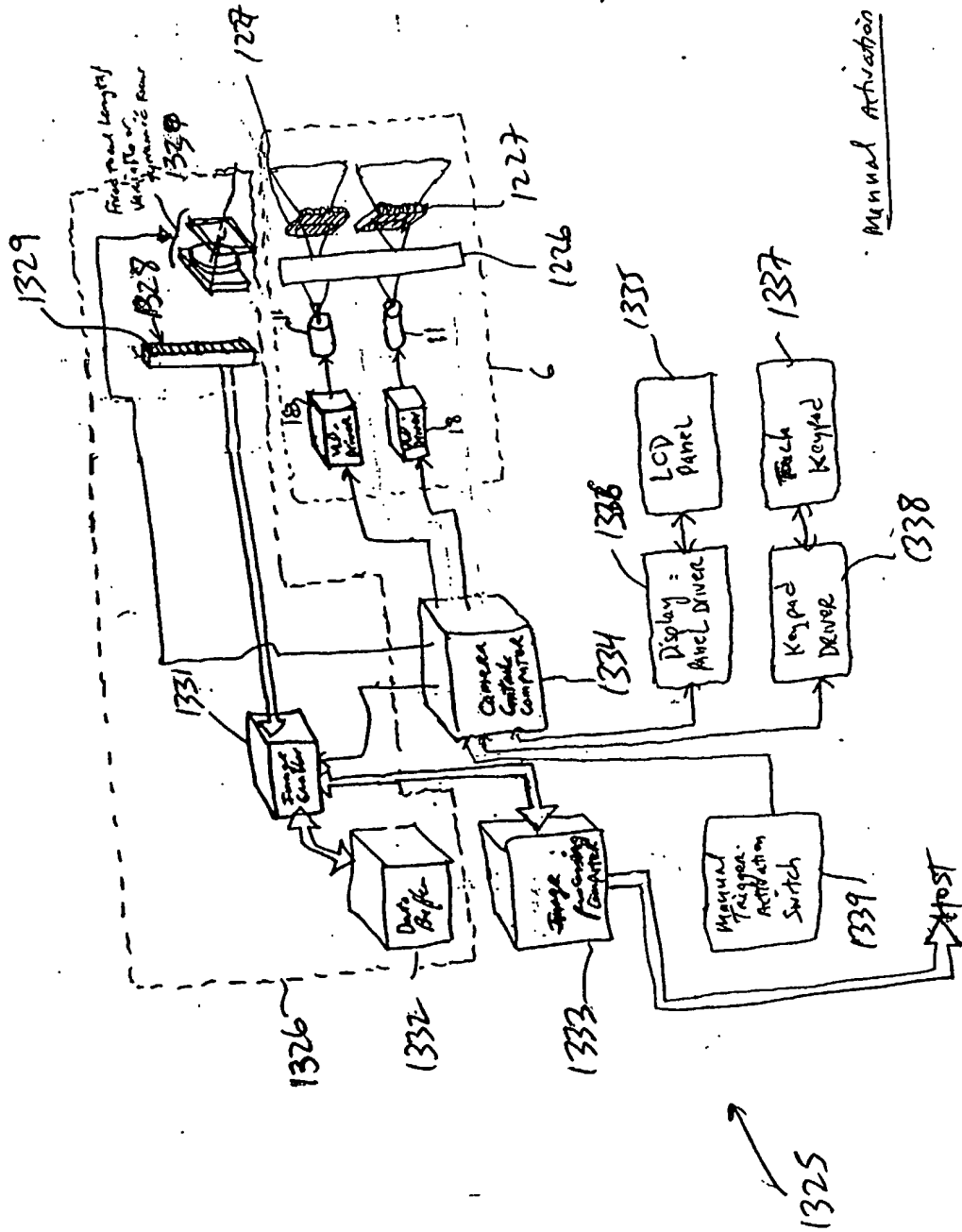


FIG. 40A5

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Annual Activation

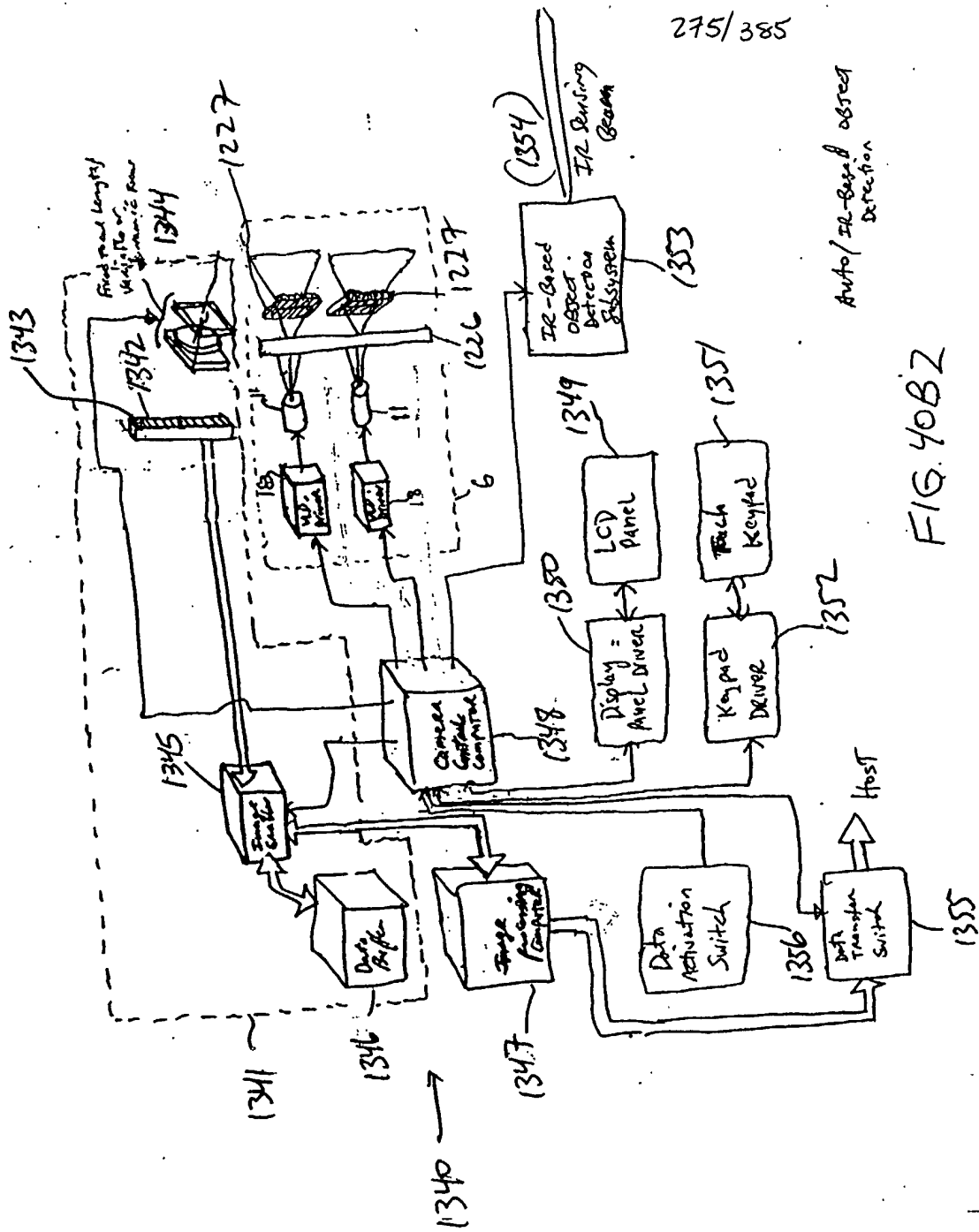
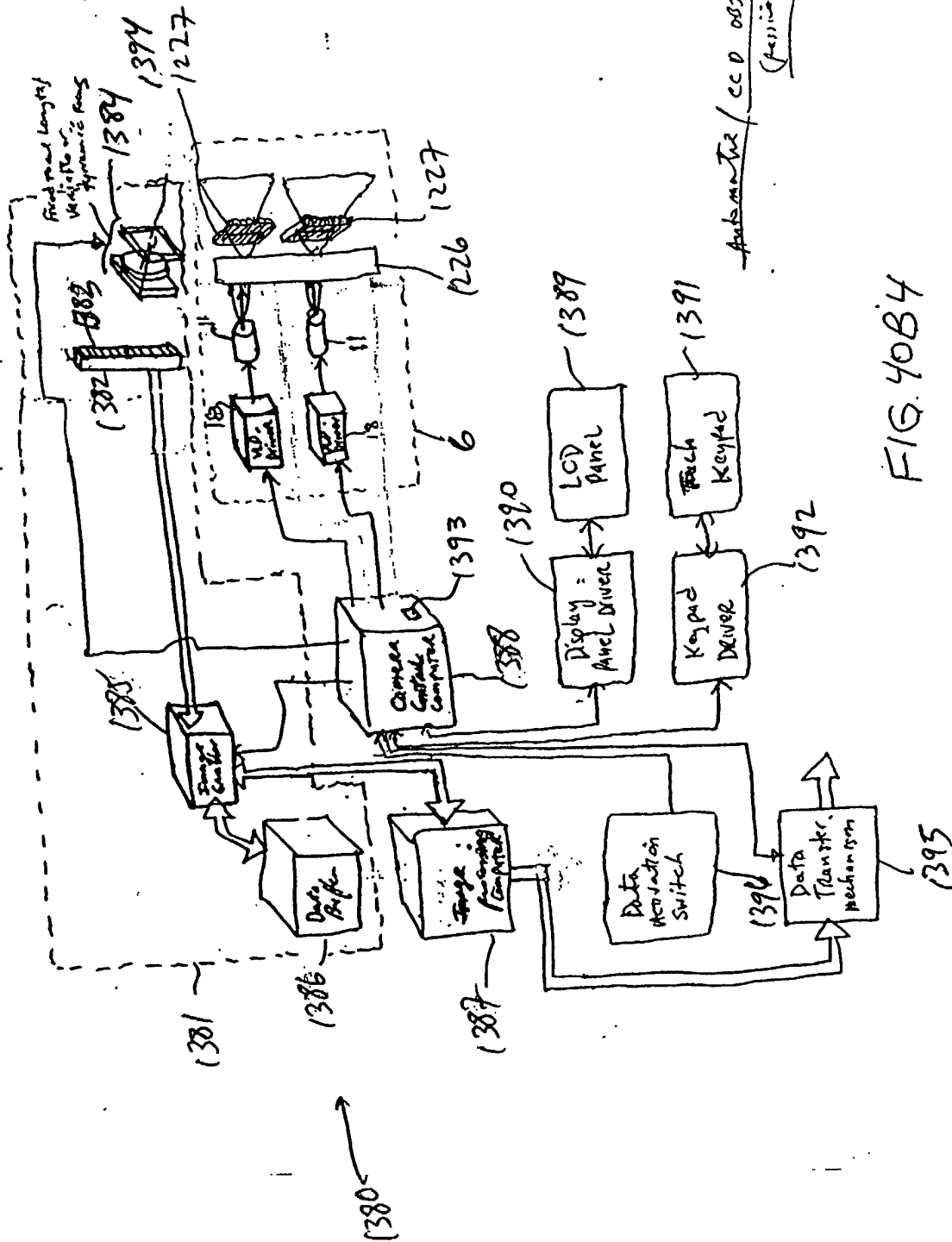
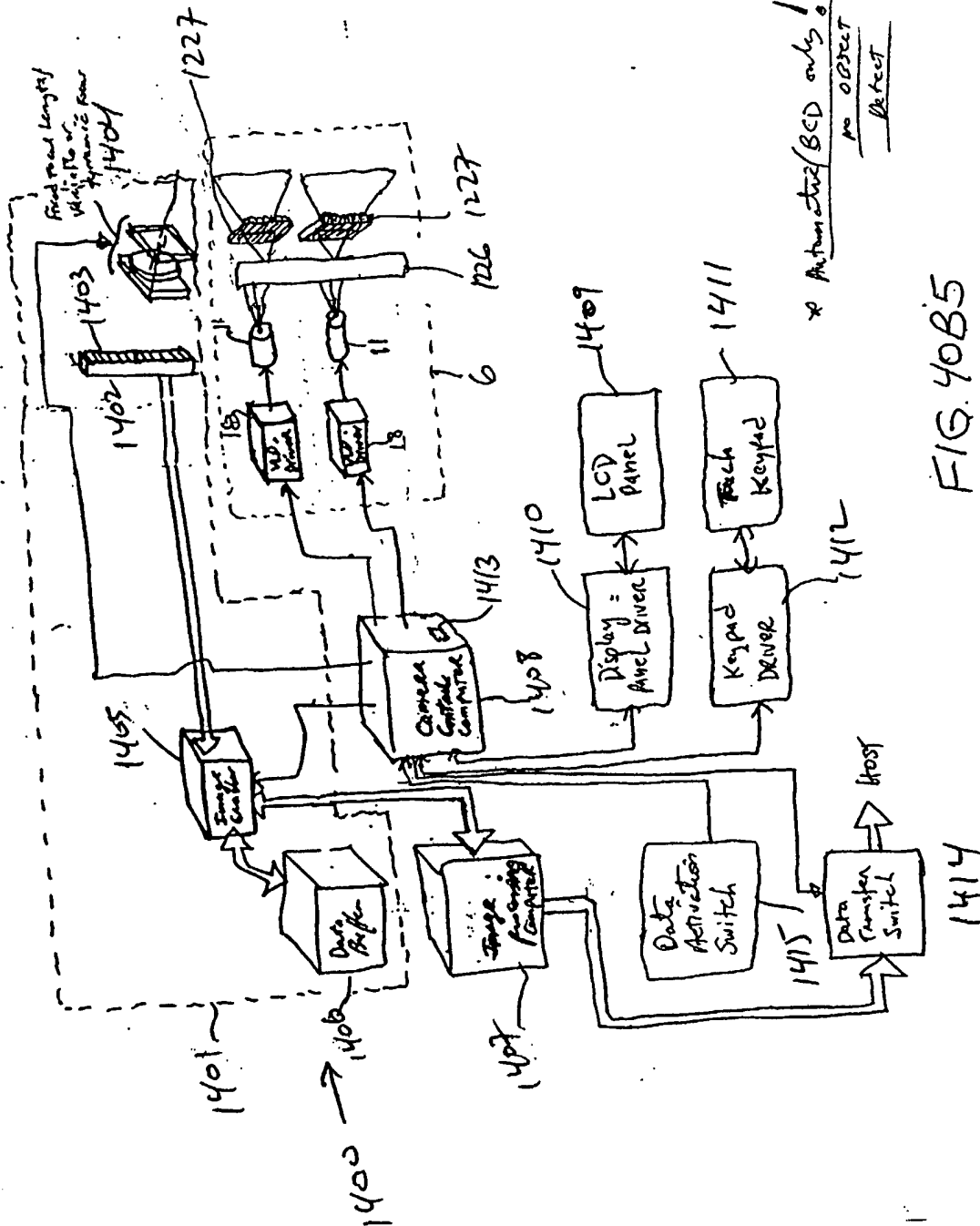


FIG. 40B2

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Antennae / CCD object detect.
(passive)





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Manual Activation

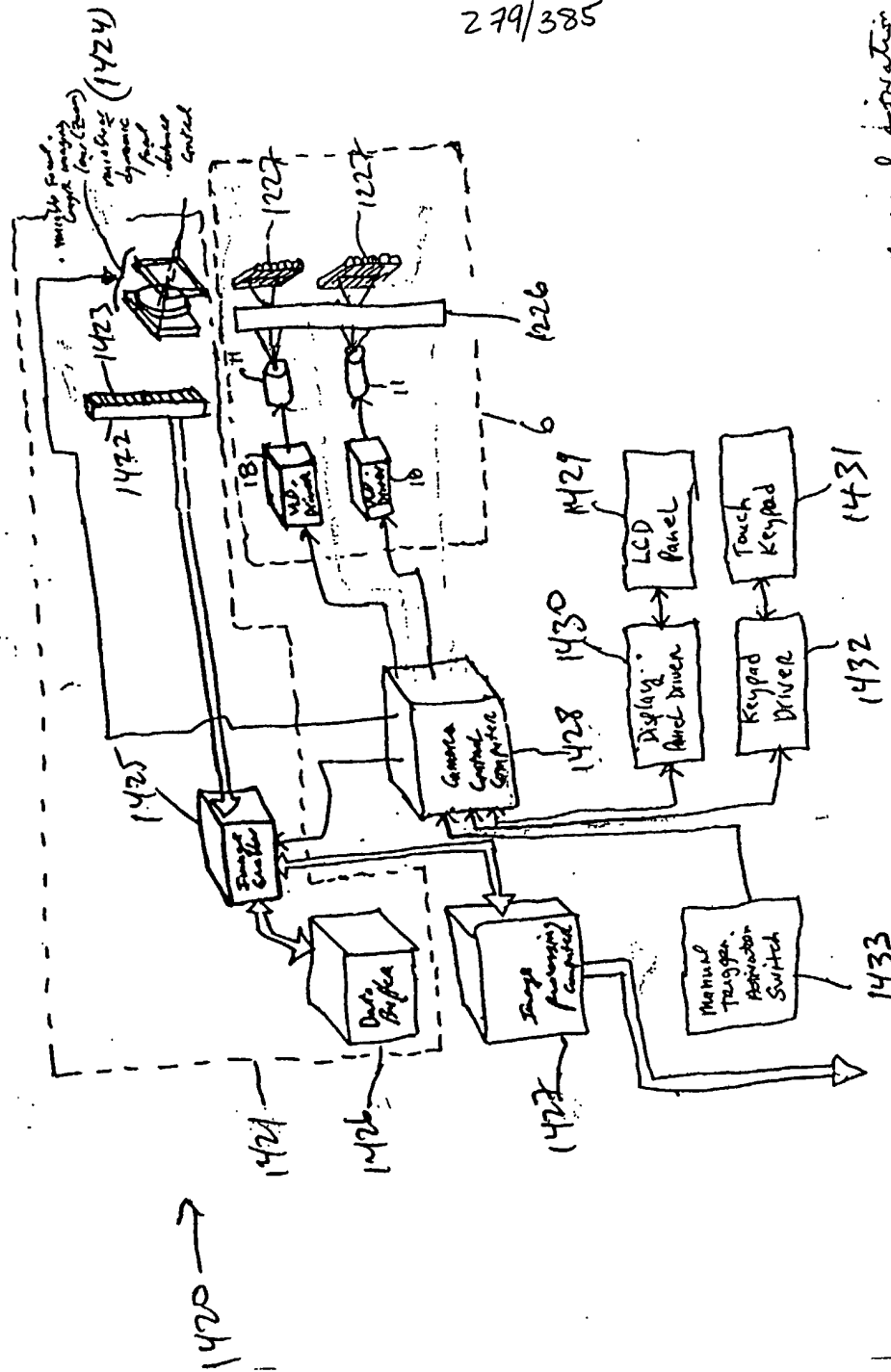


FIG. 40C1

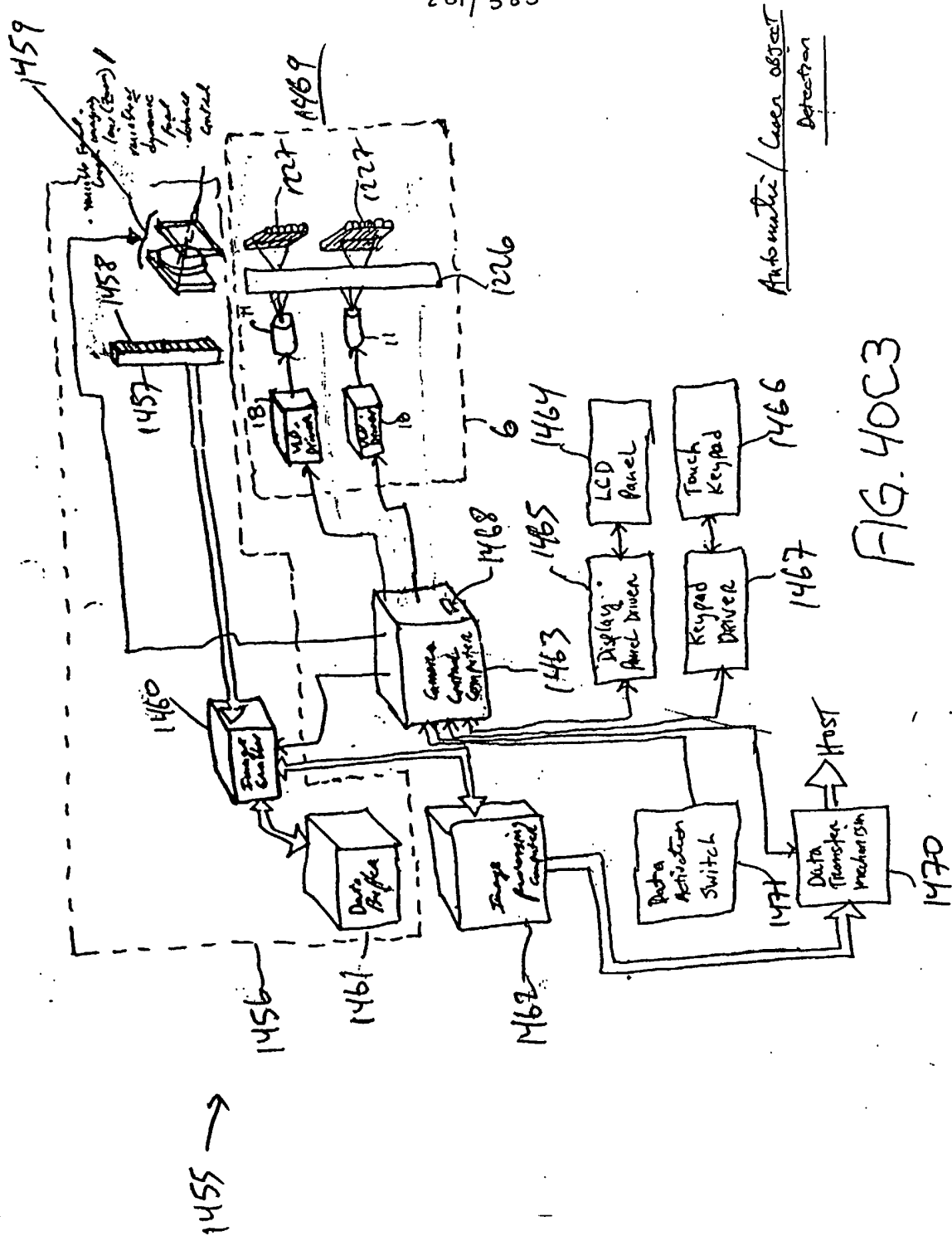
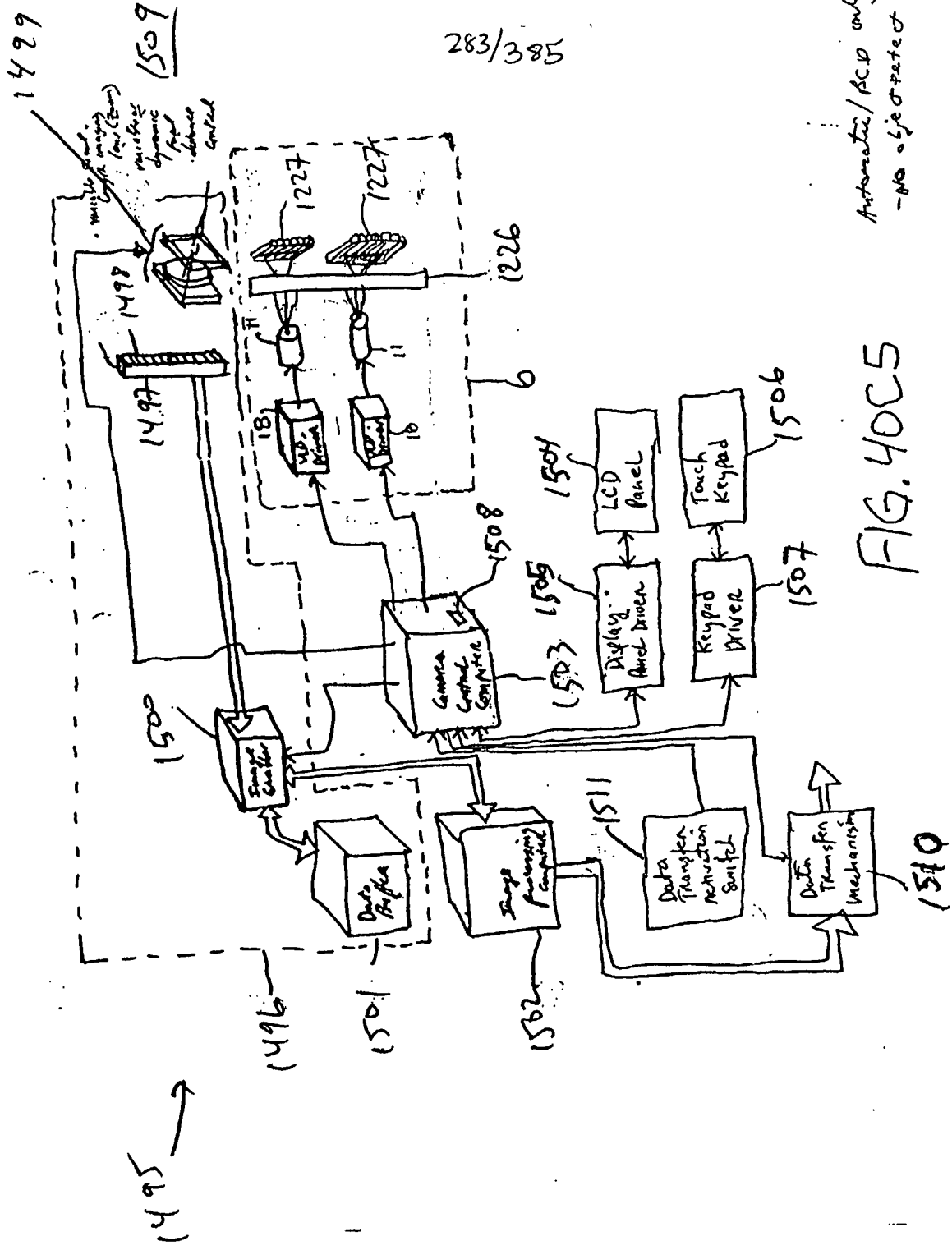


FIG. 40C3

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Automatic/PCD only
- no object data

FIG. 40C5

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1-D
display
...

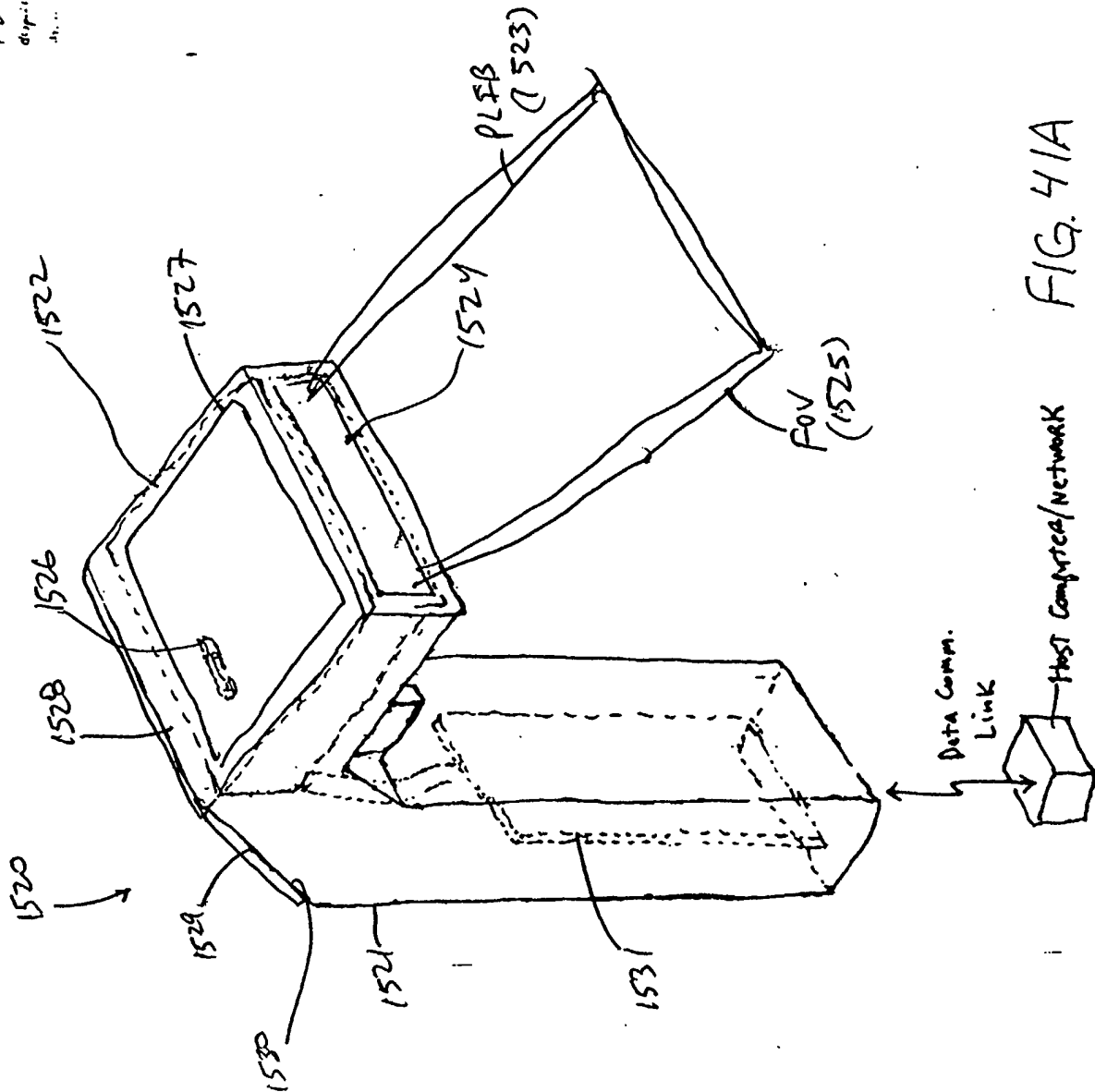


FIG. 41A

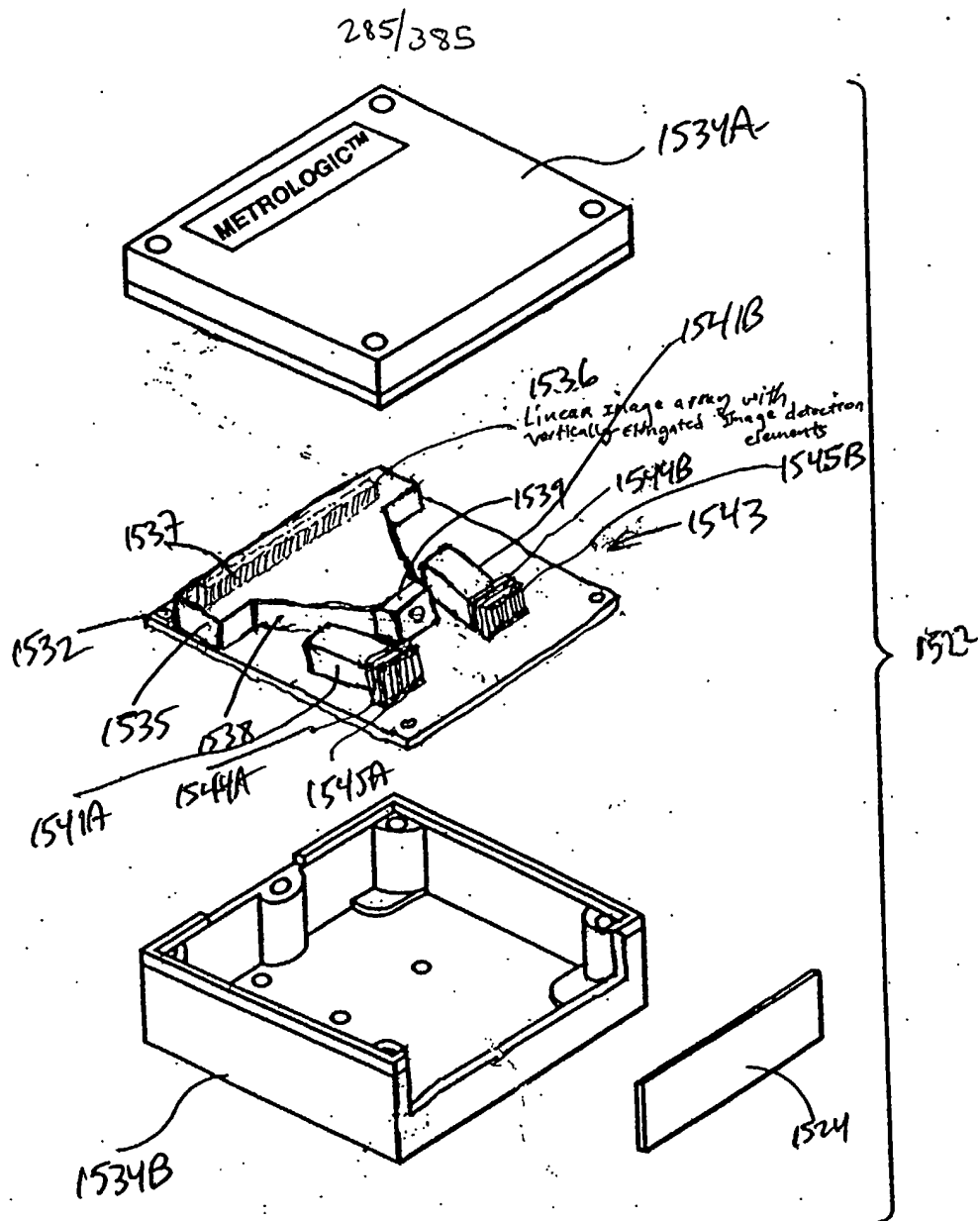


FIG. 41B

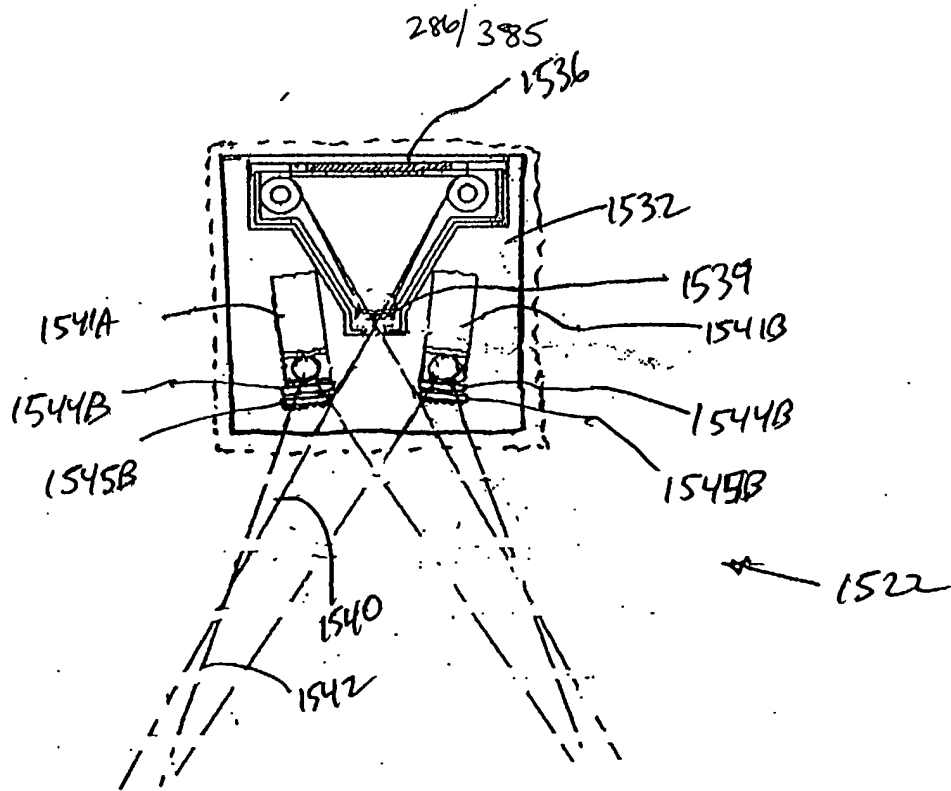


FIG. 41C

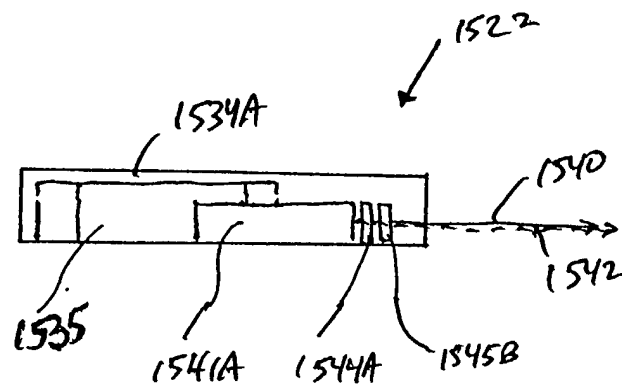
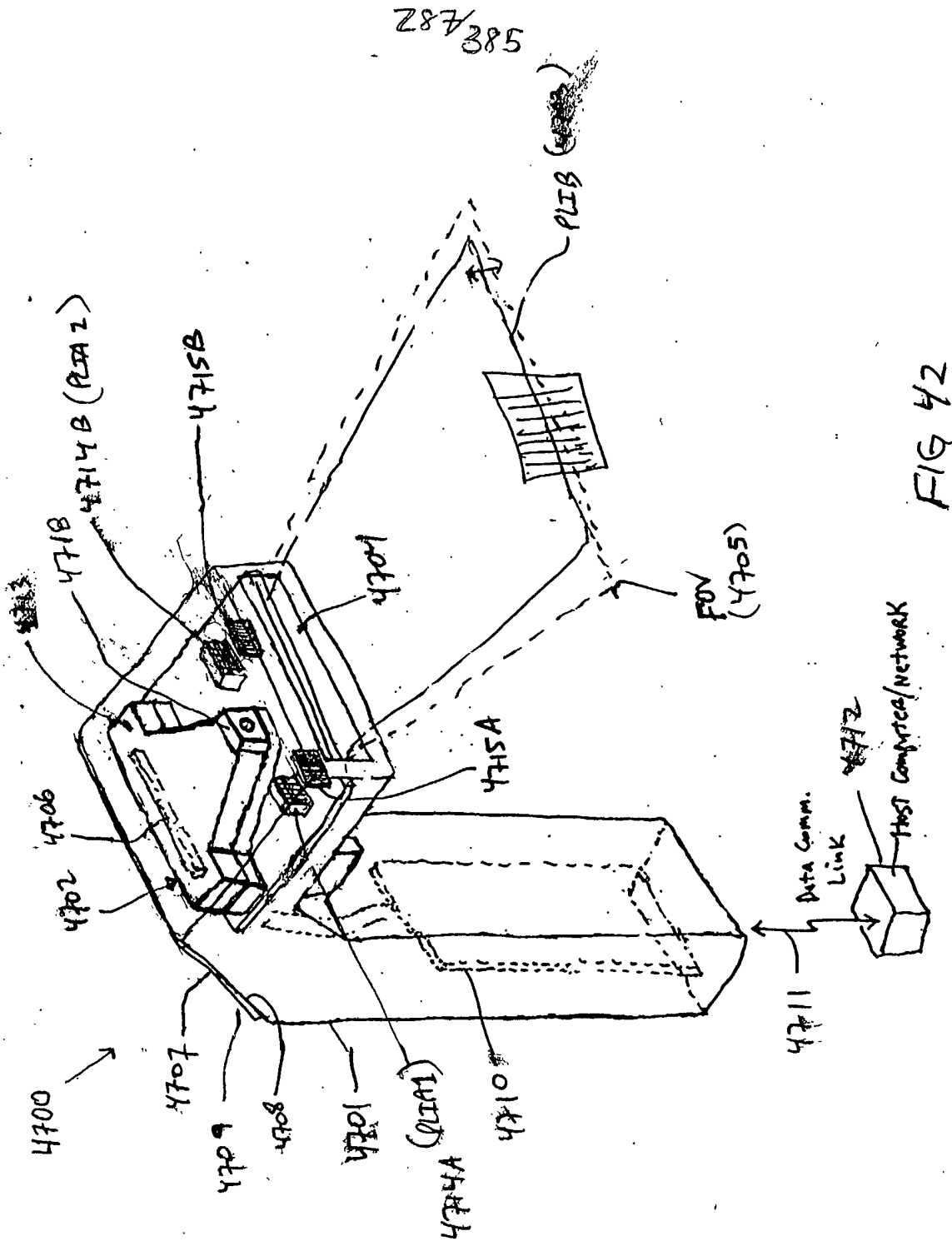


FIG. 41D



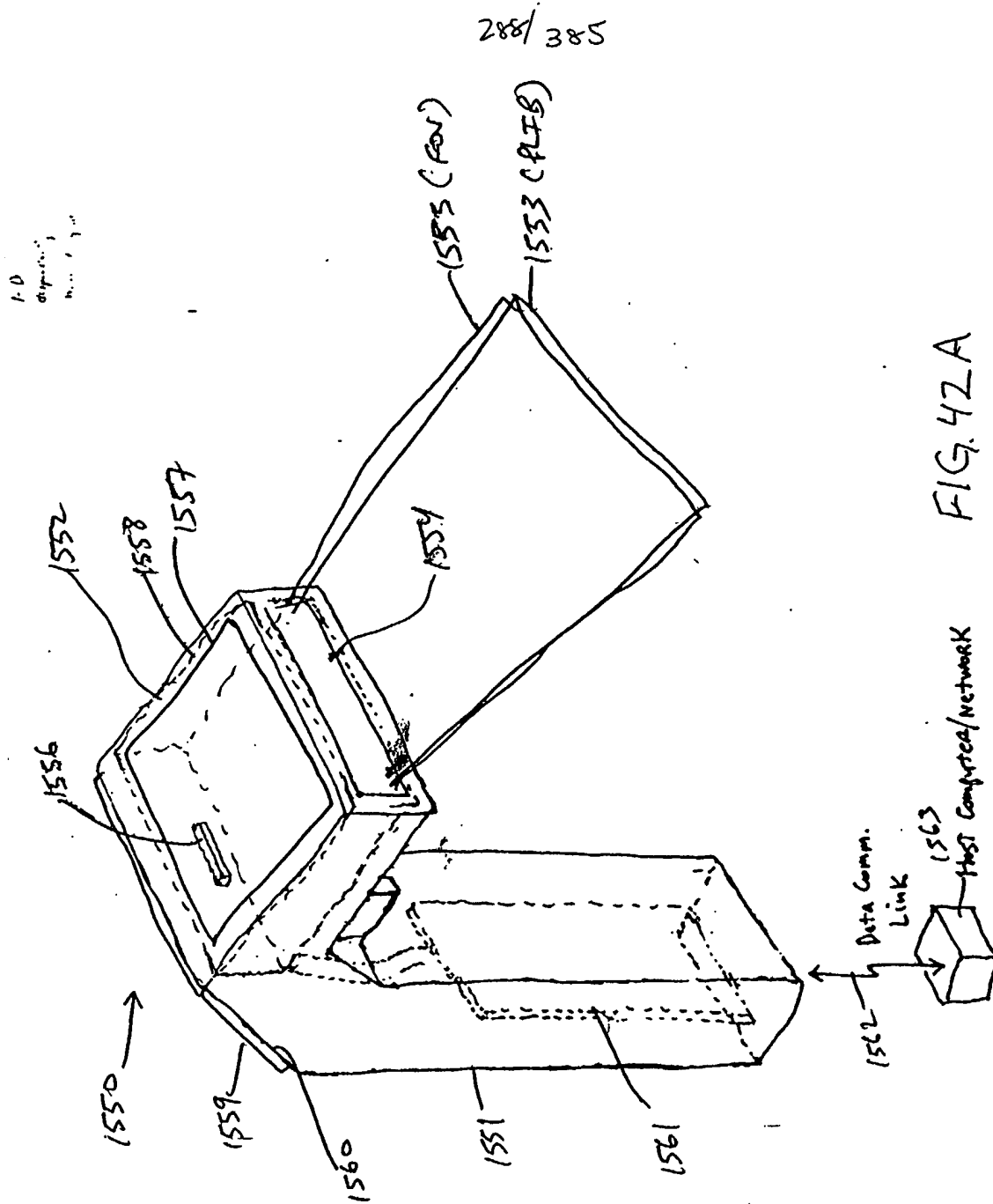


FIG. 42A

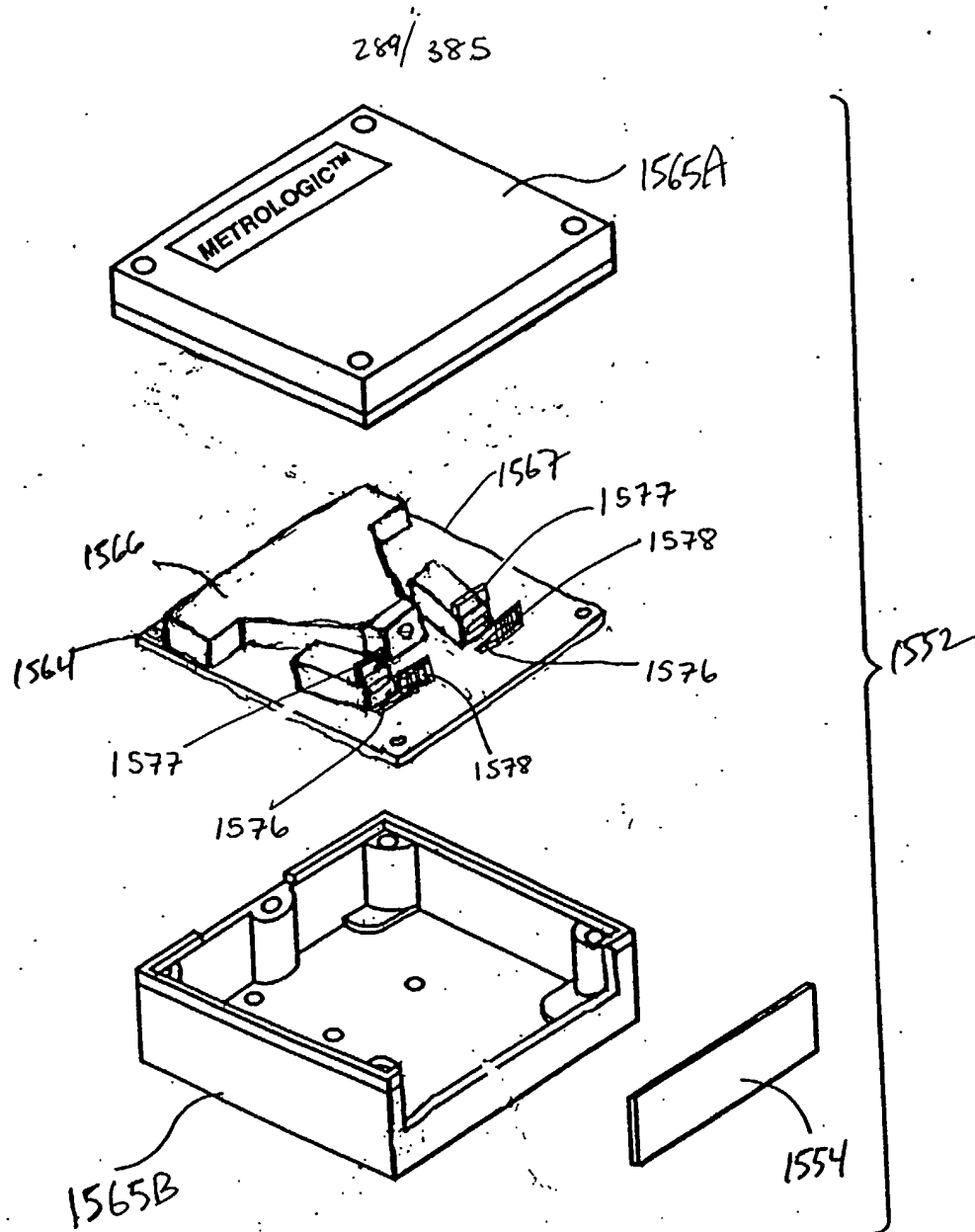


FIG. 42B

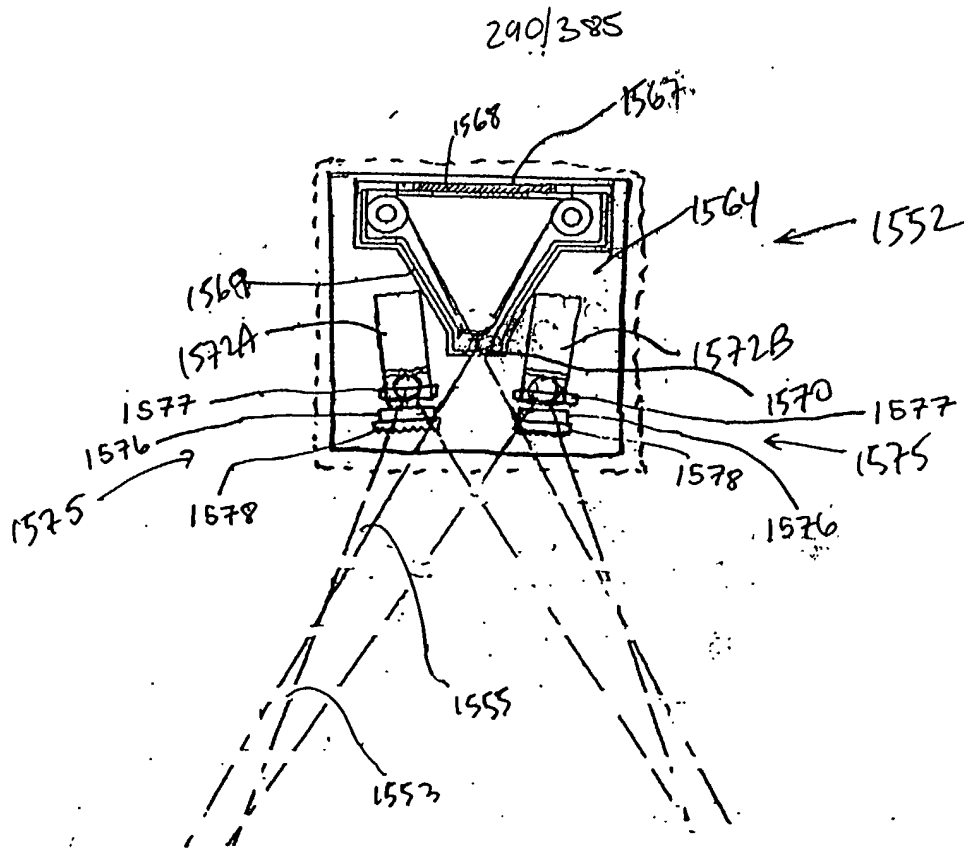


FIG. 42C

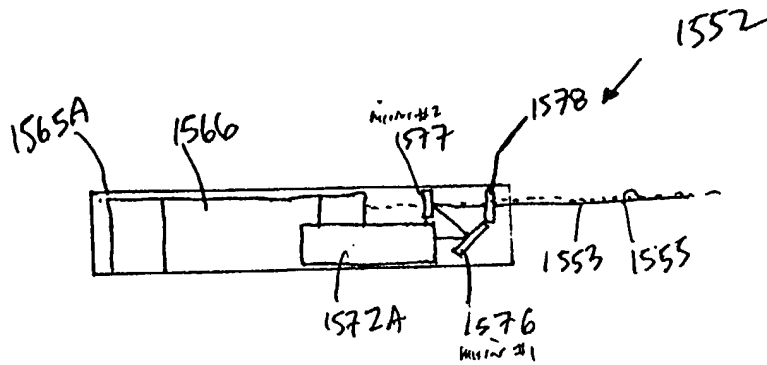


FIG. 42D

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1-D
display
area

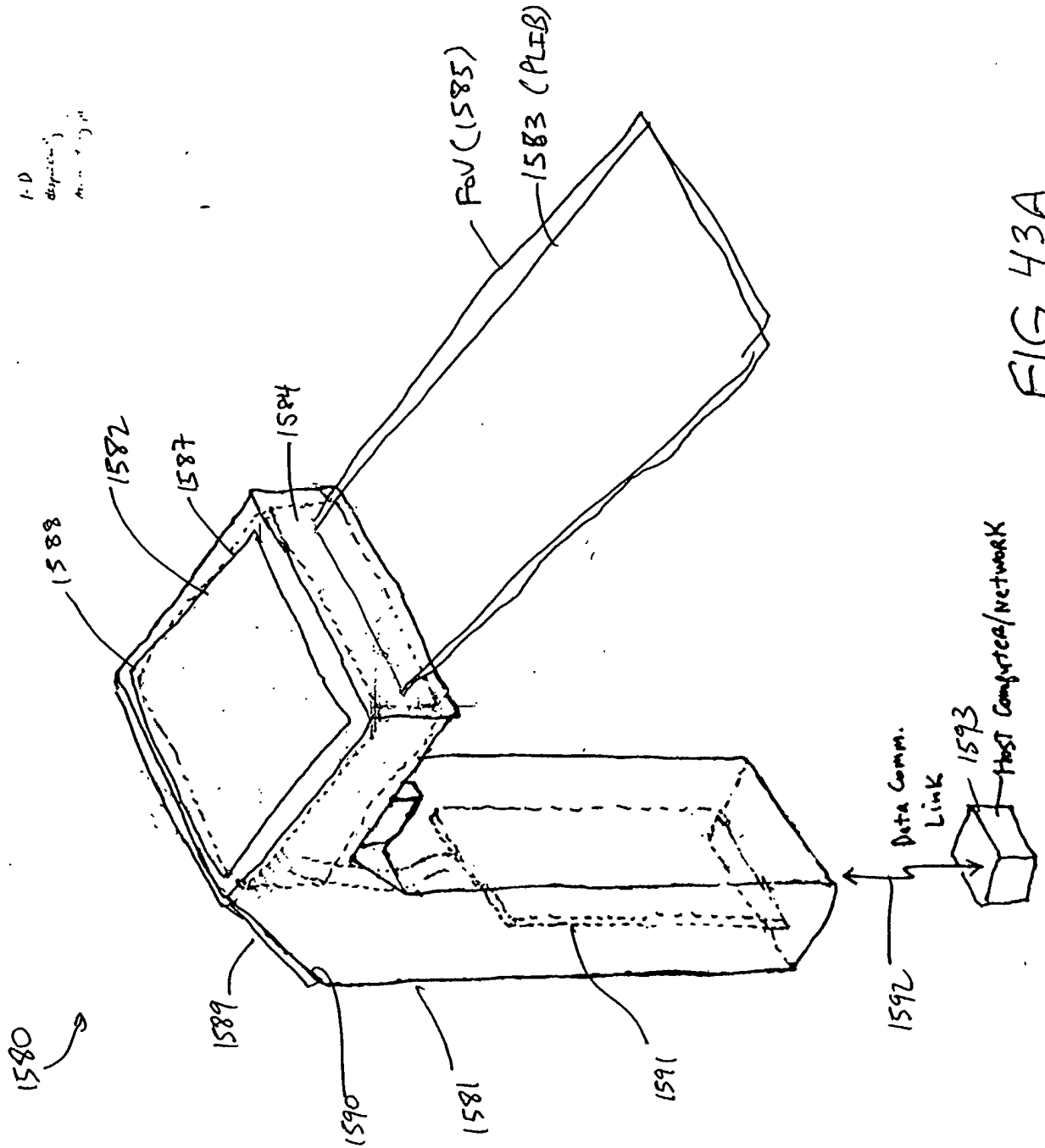


FIG. 43A

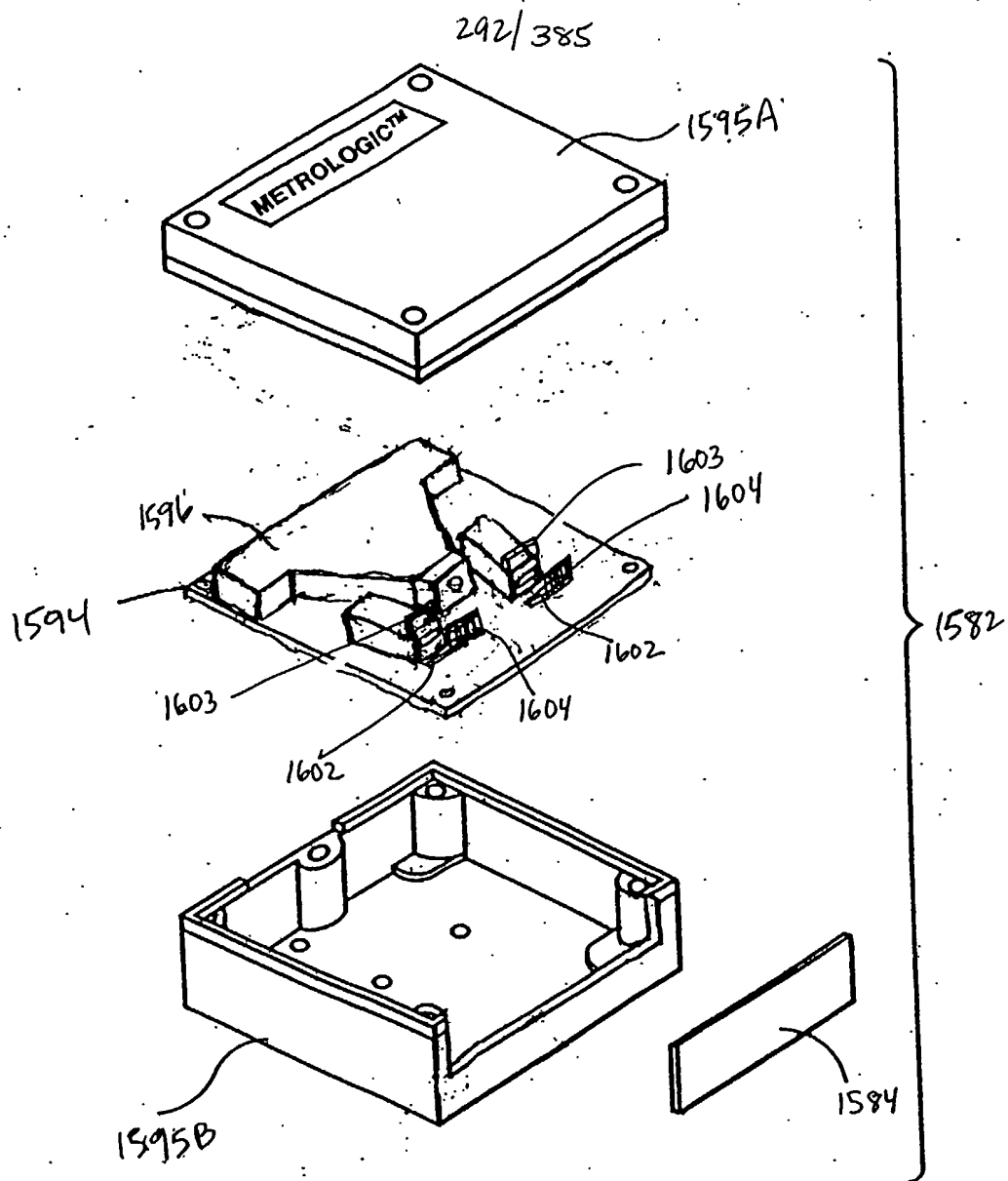


FIG. 43B

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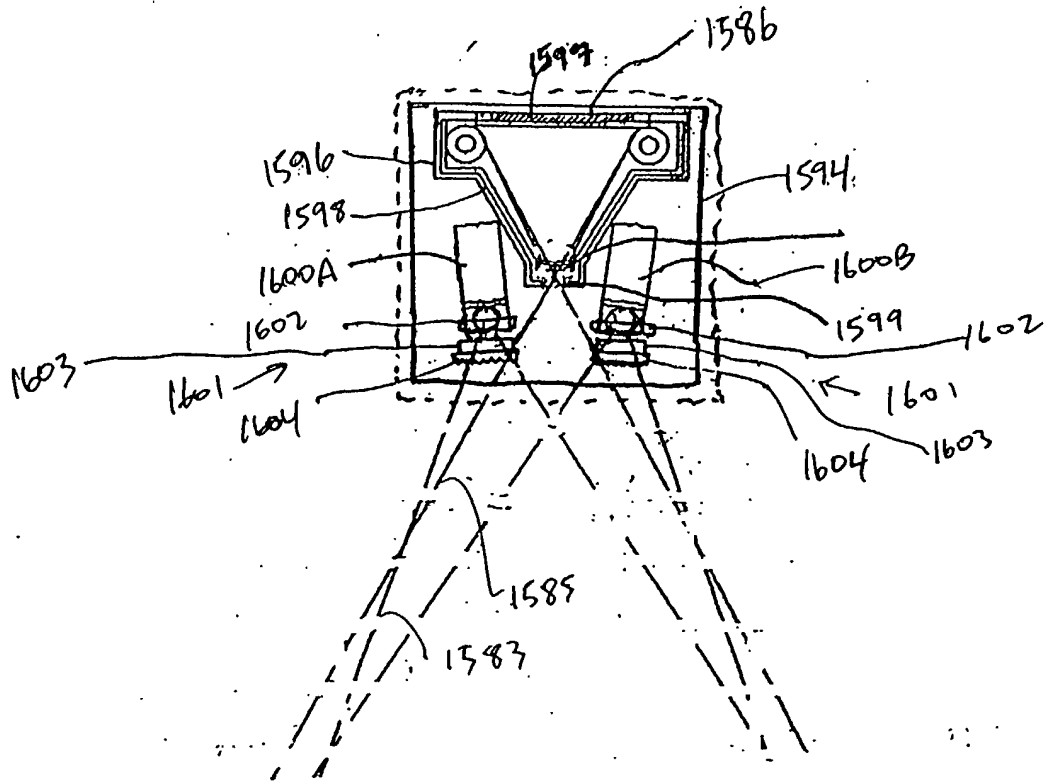


FIG. 43C

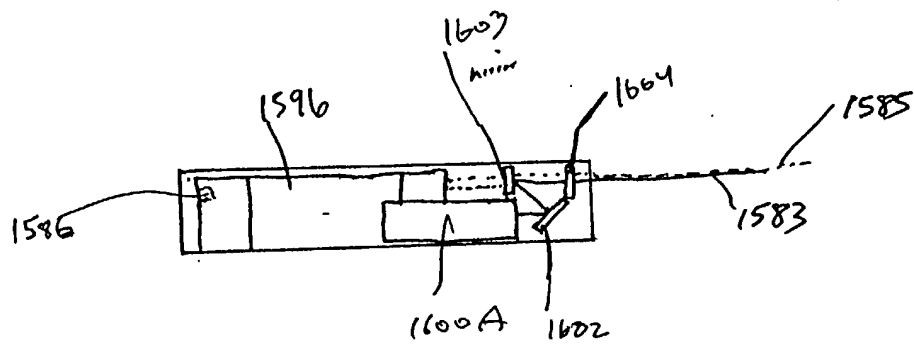
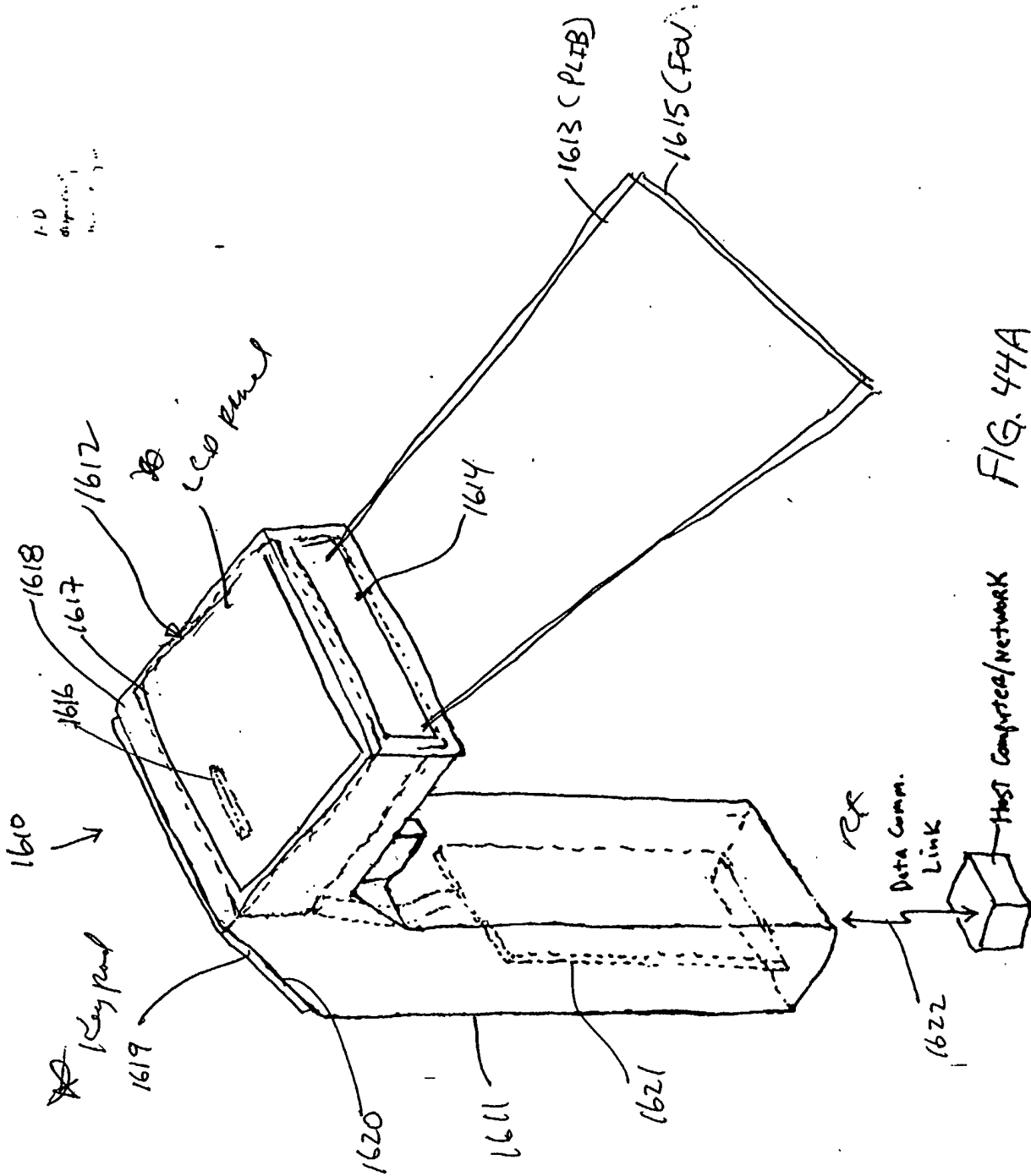


FIG. 43D

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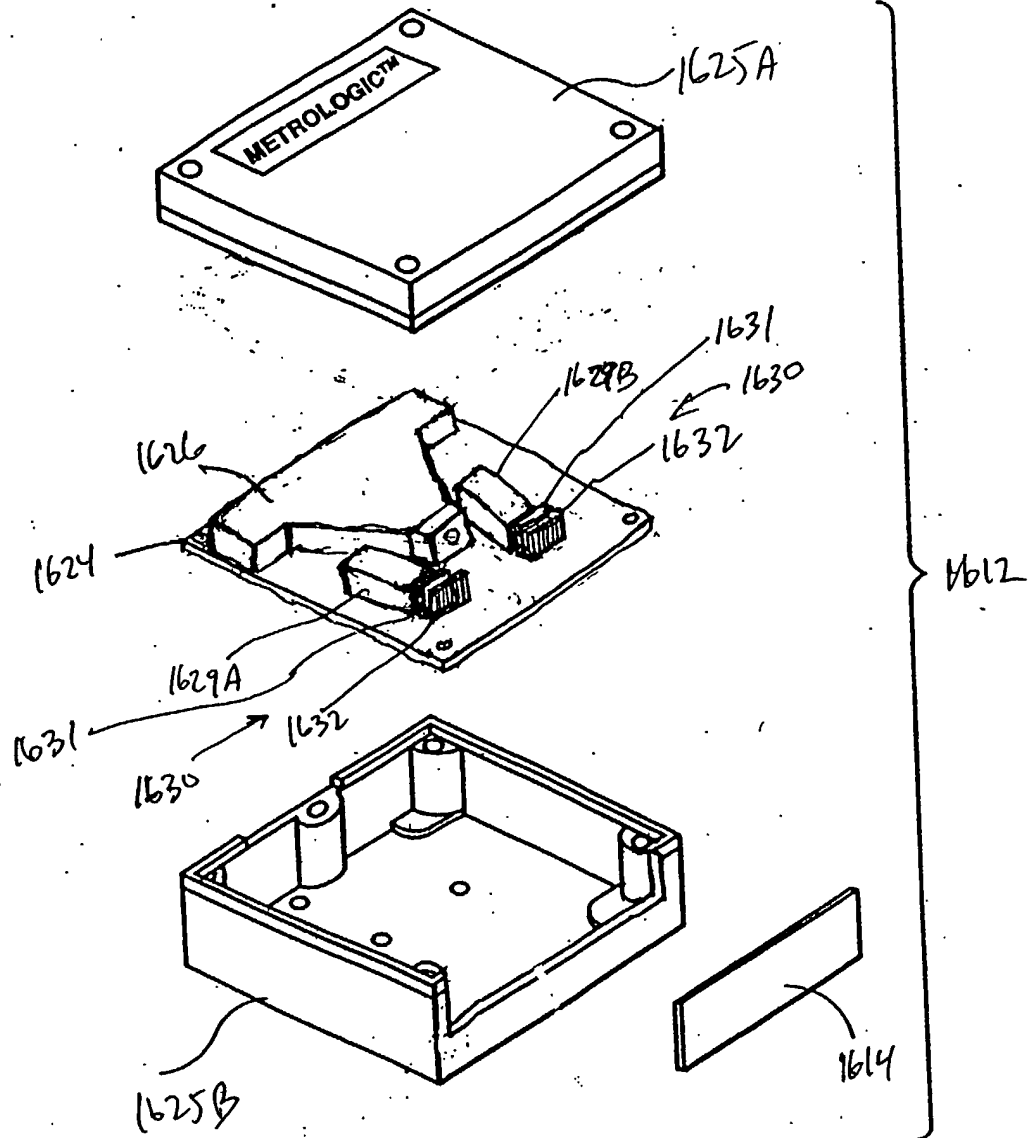
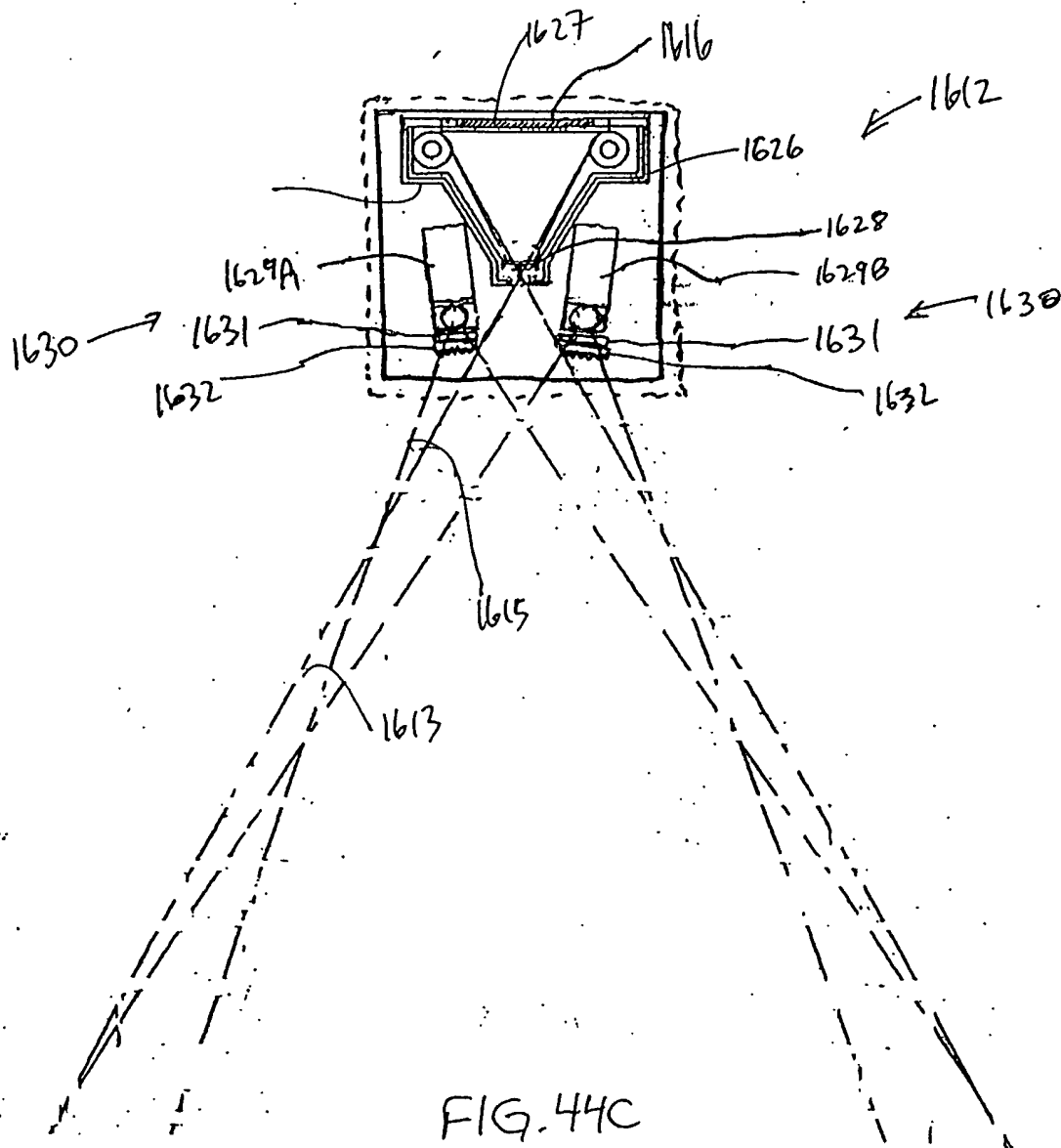


FIG. 44B

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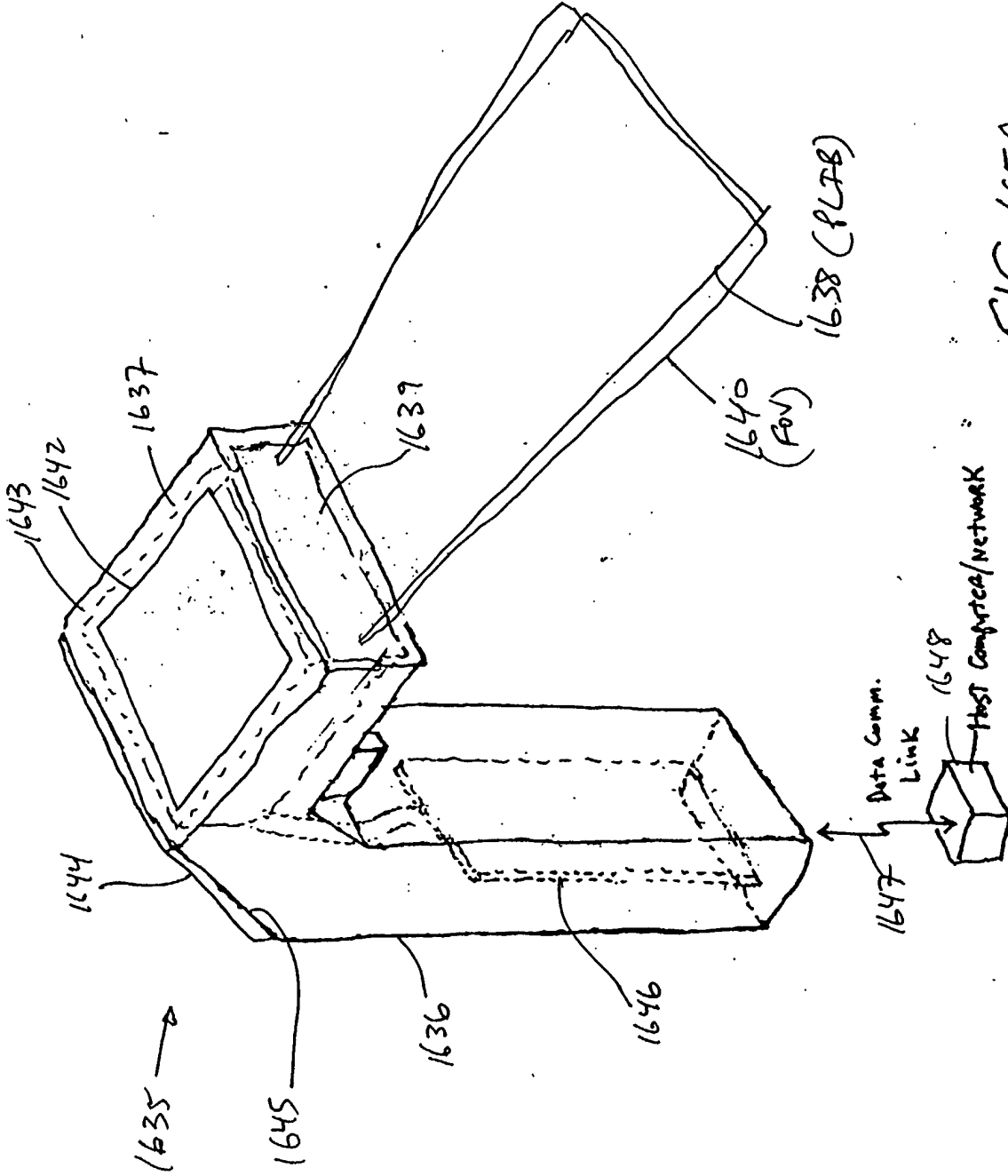


FIG. 45A

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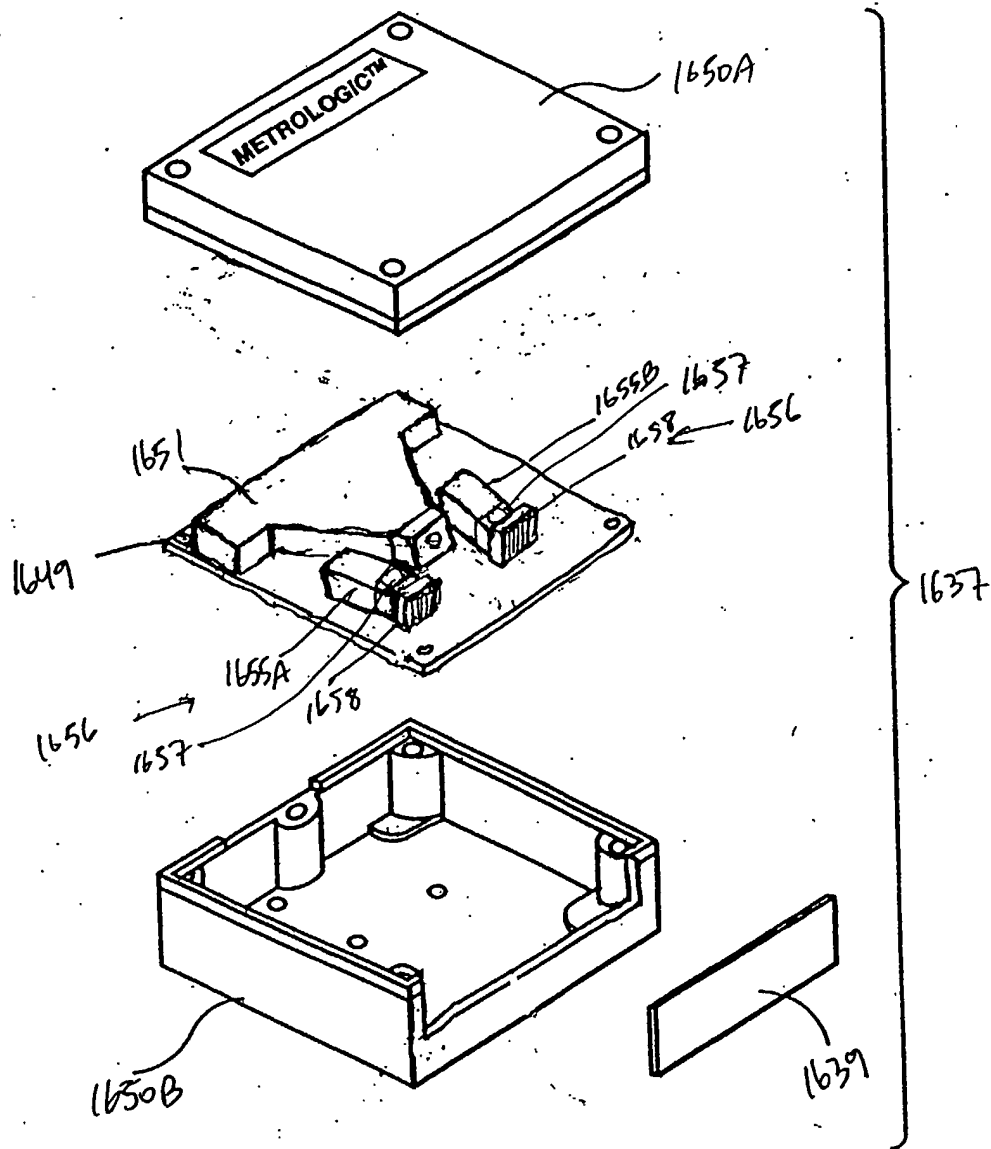


FIG. 45B

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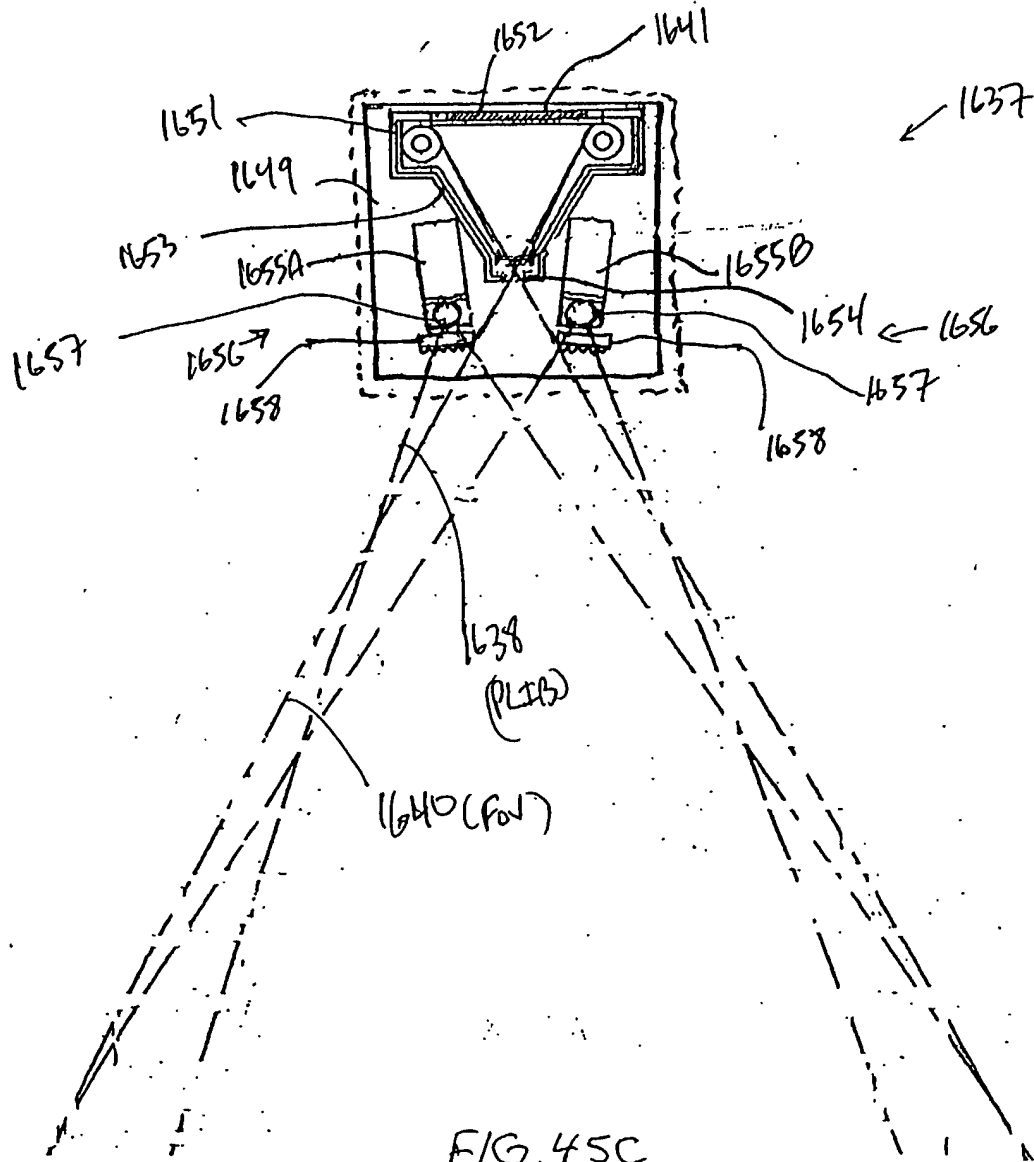
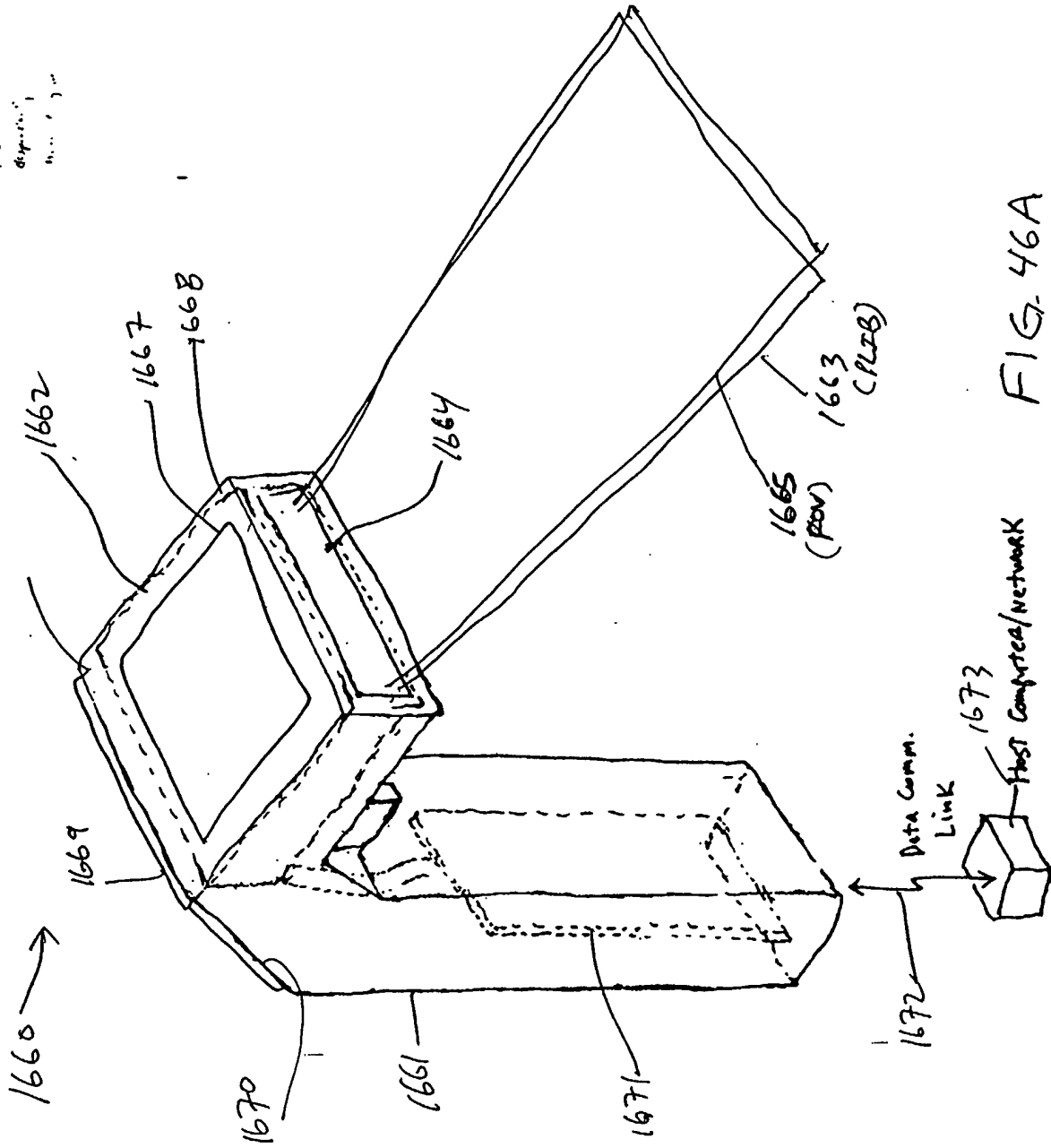


FIG. 45C

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1-D
deg. m.
m. m. m.



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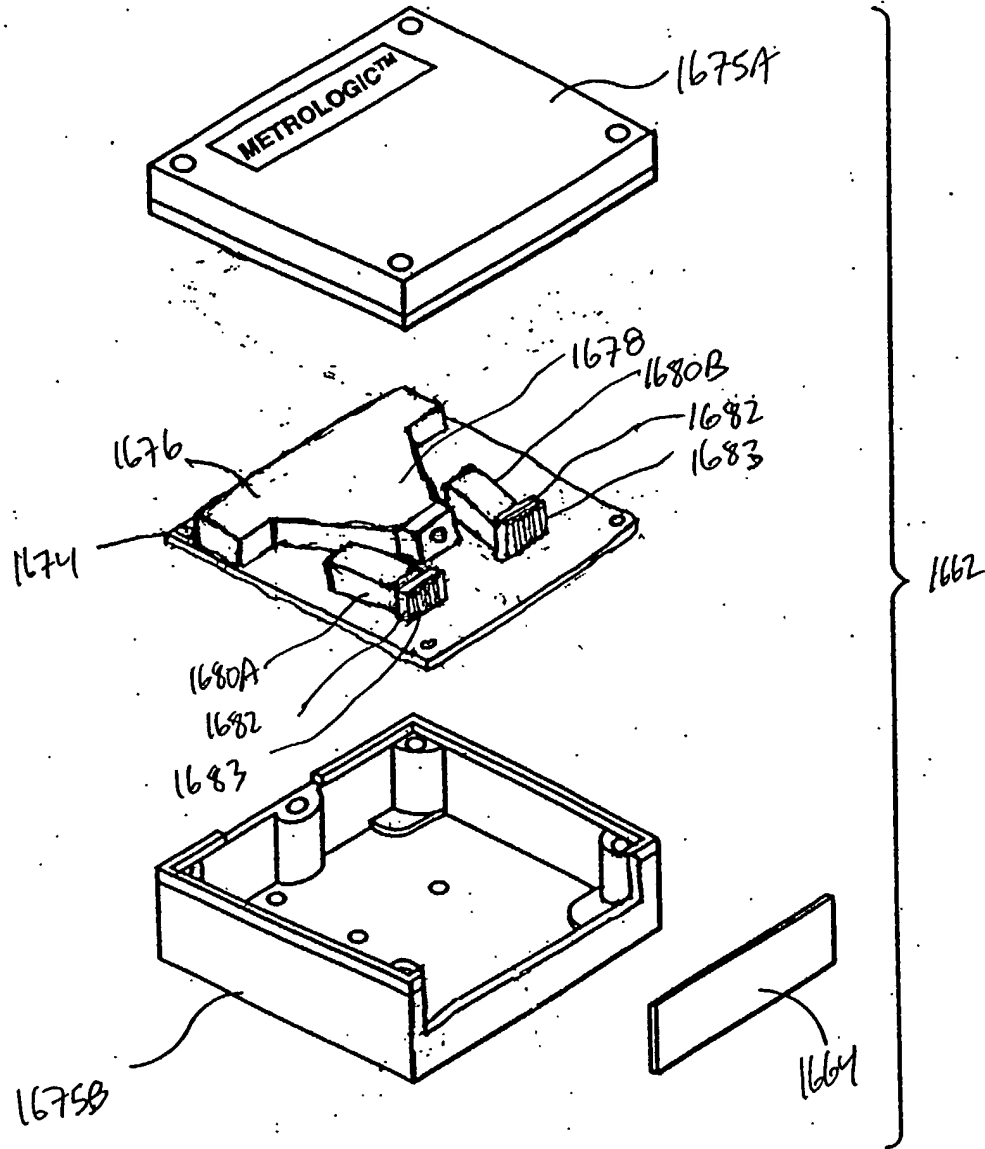
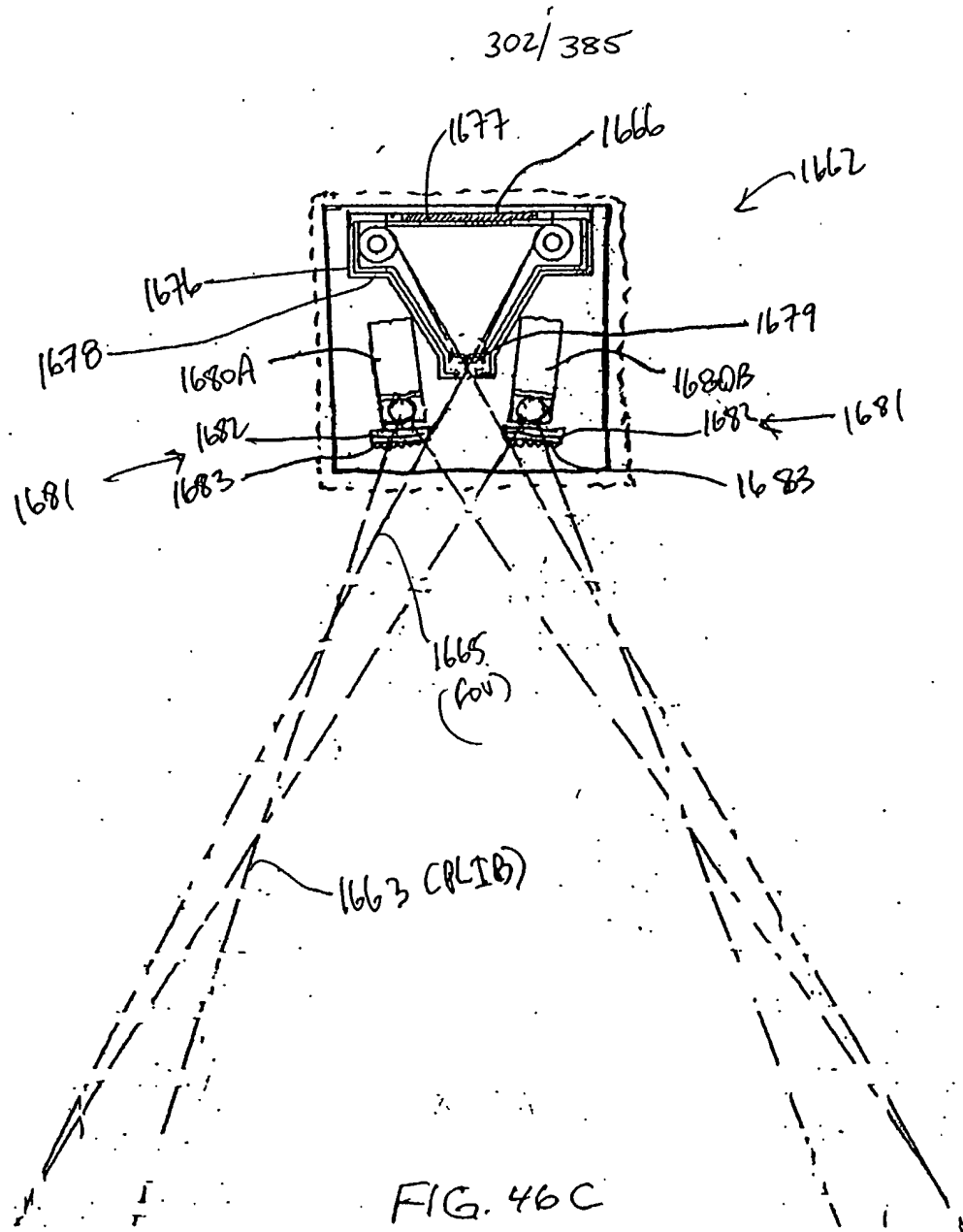


FIG. 46B



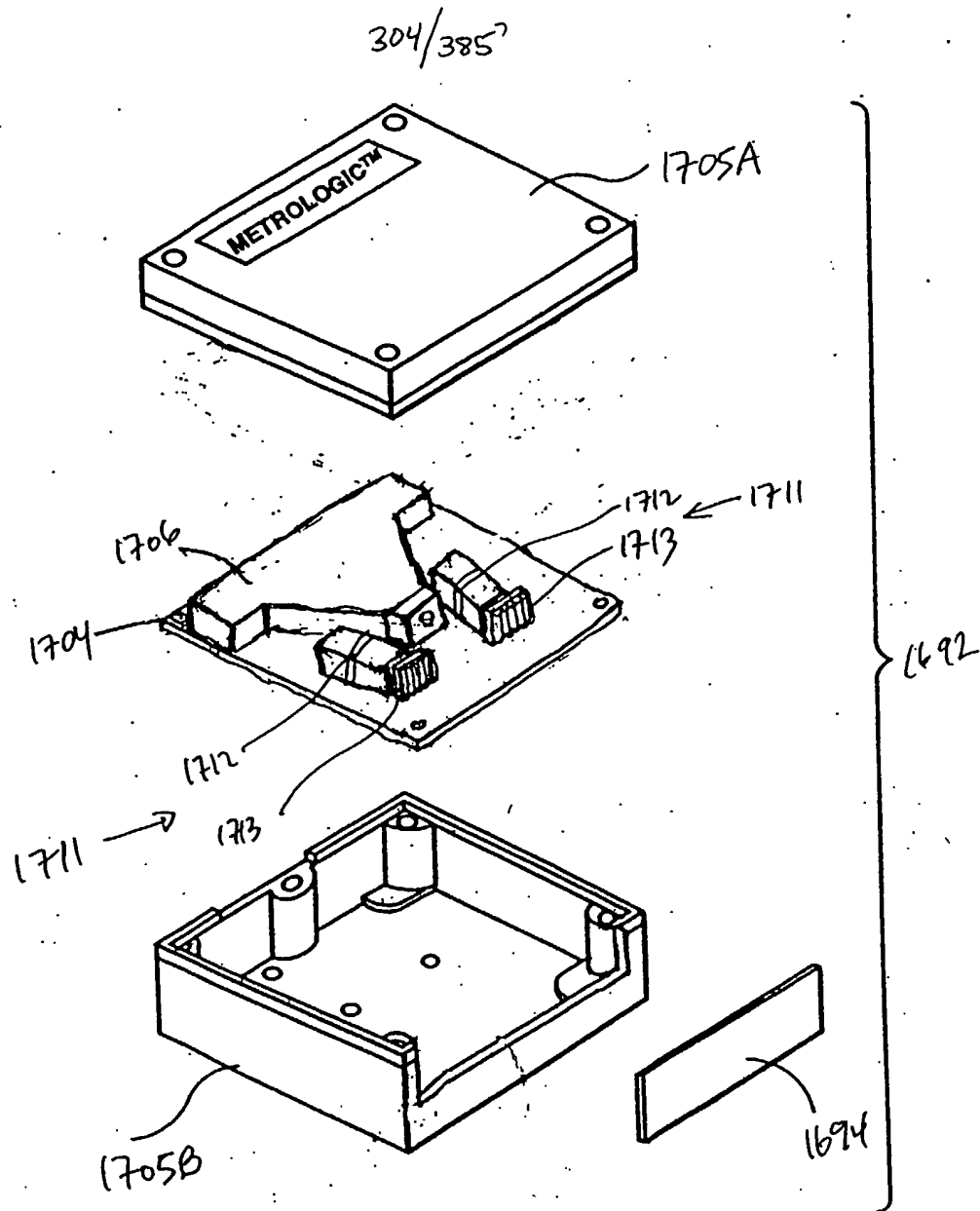
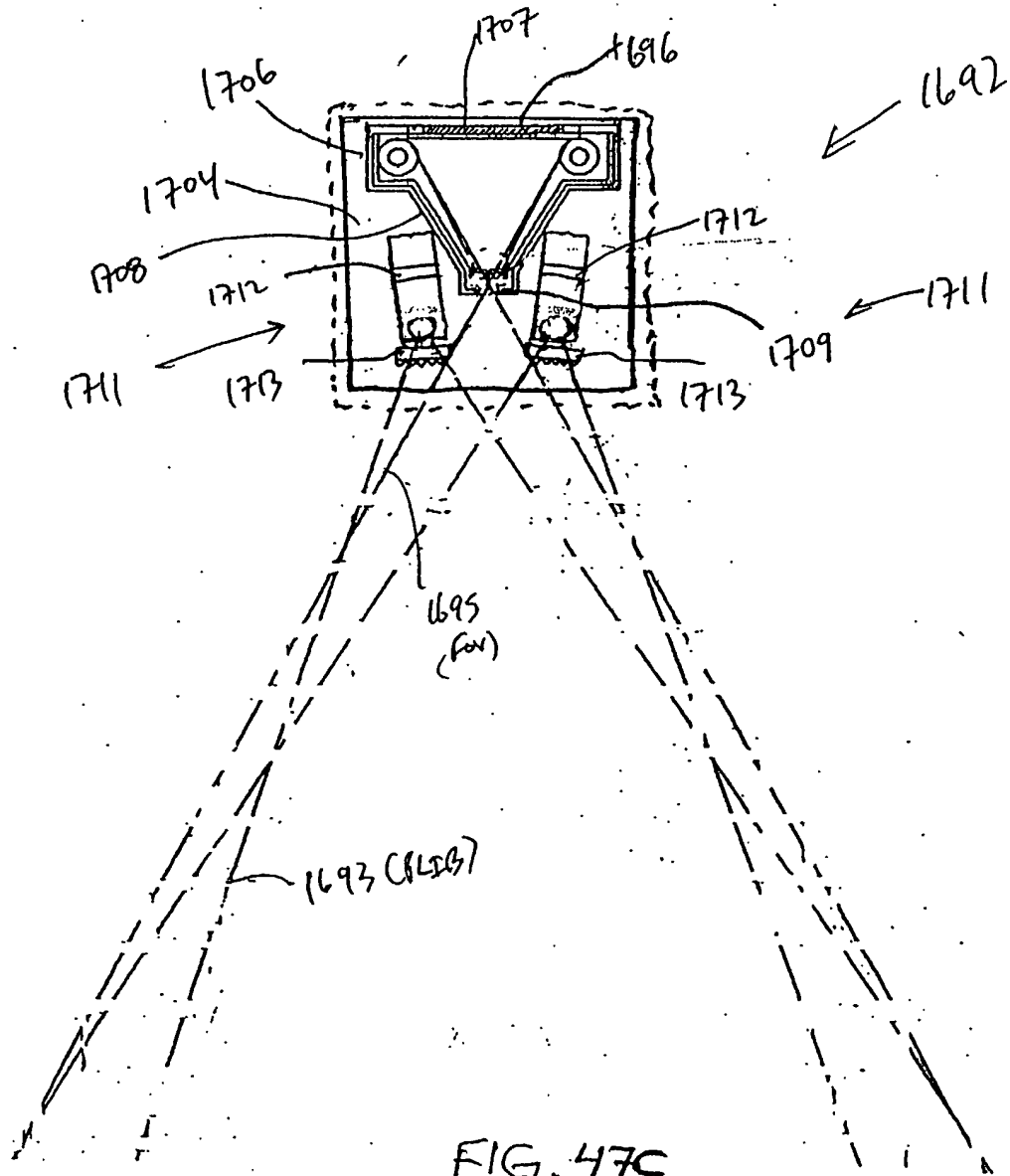


FIG. 47B

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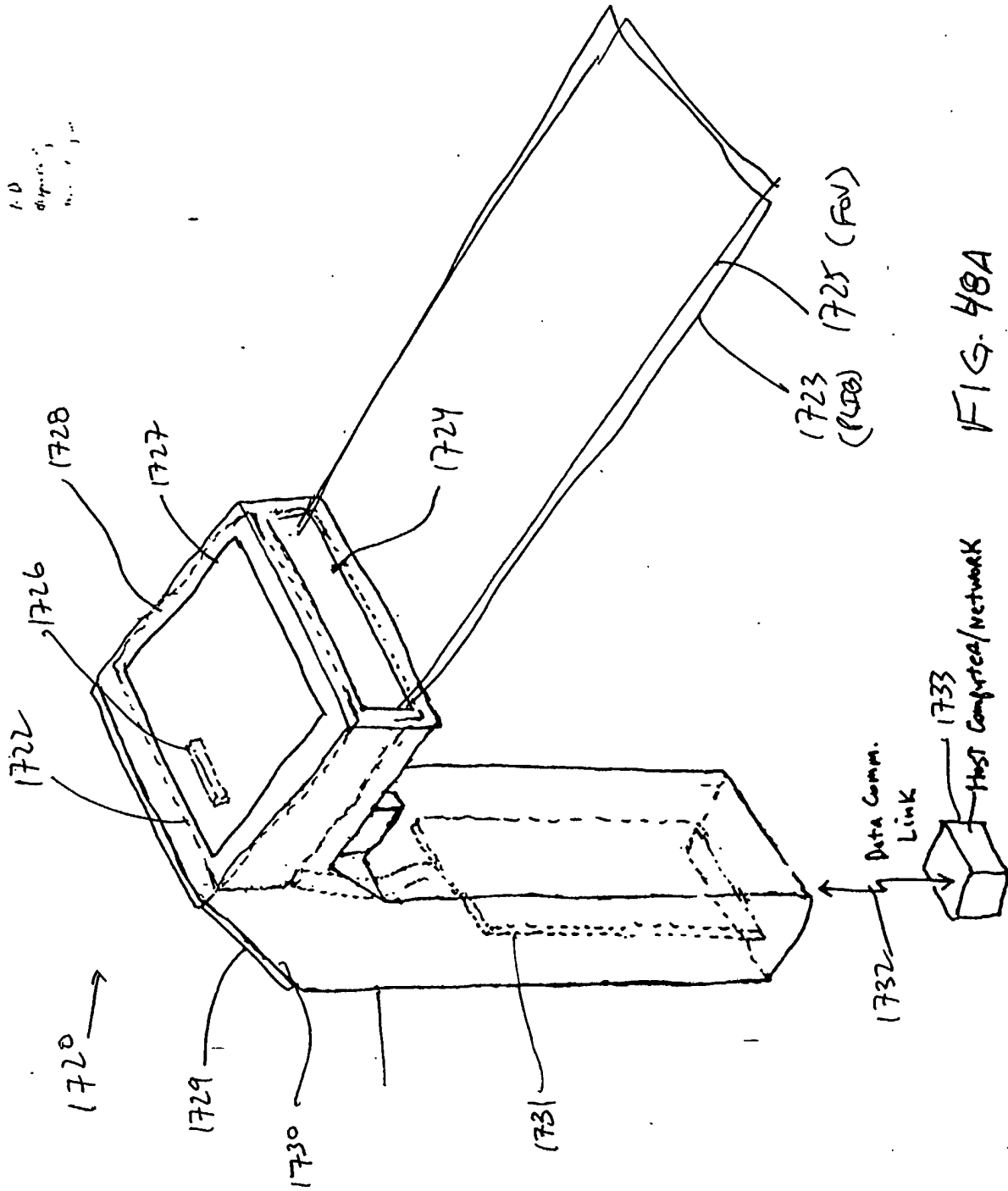


FIG. 48A

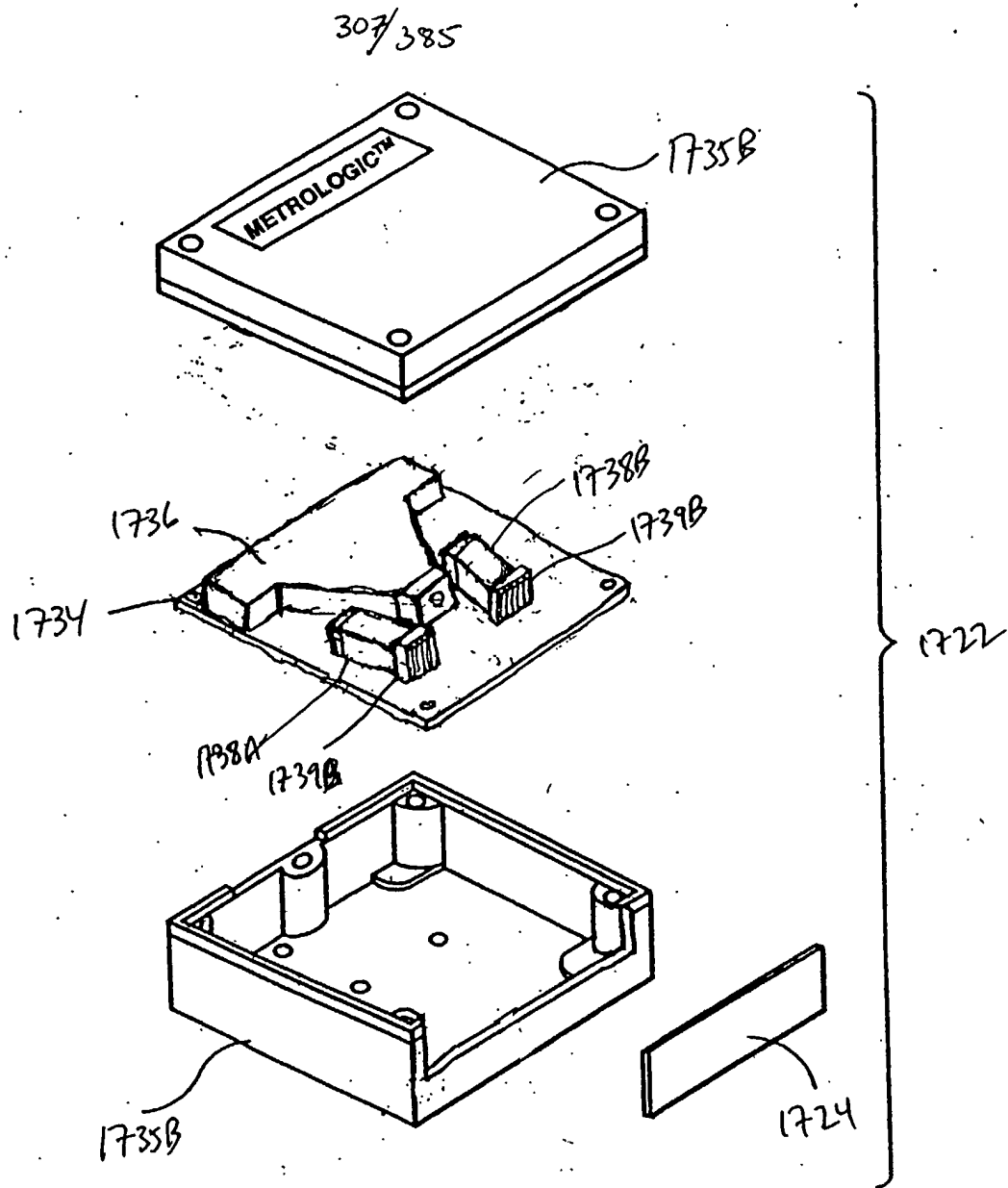
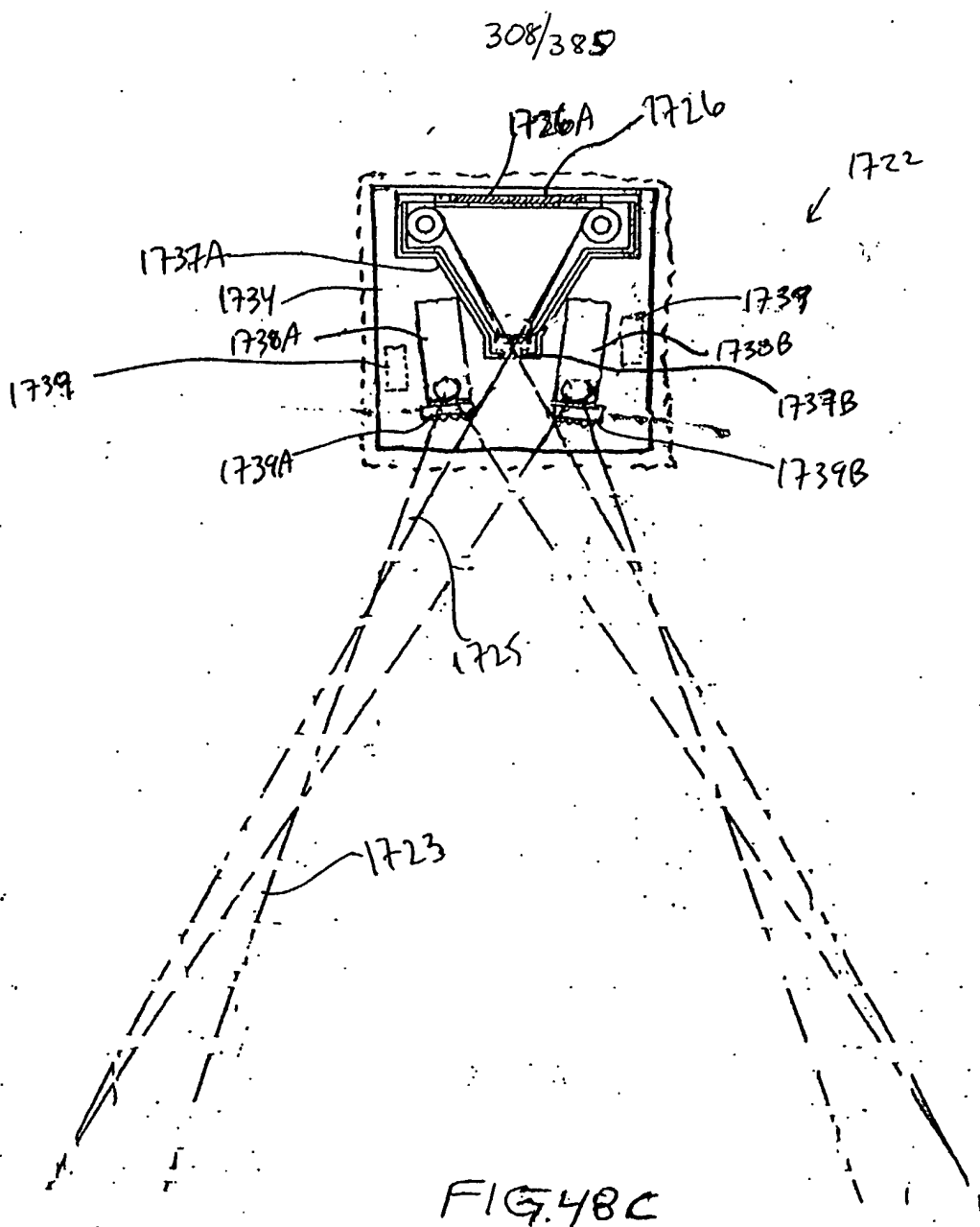


FIG. 48B



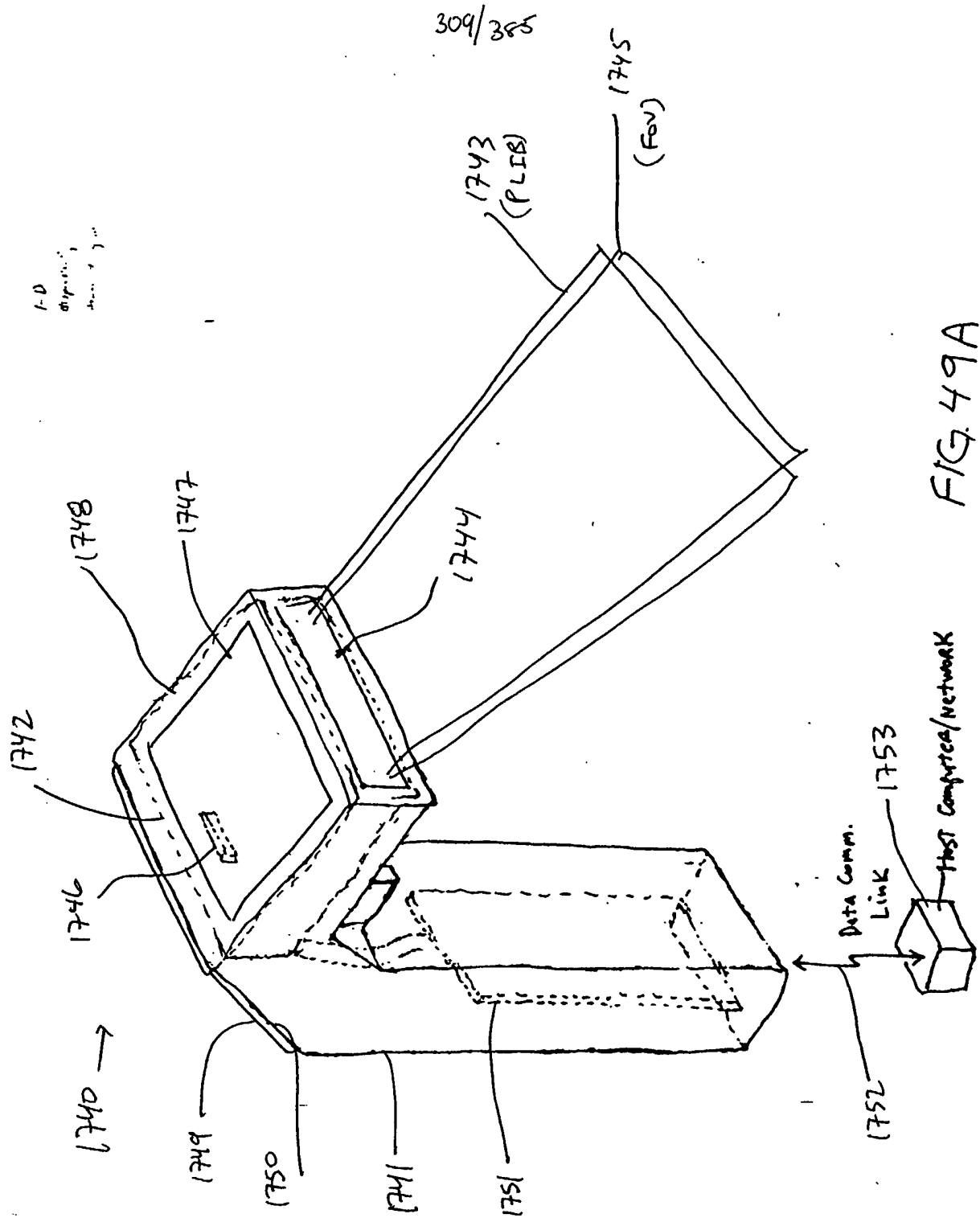


FIG. 49A

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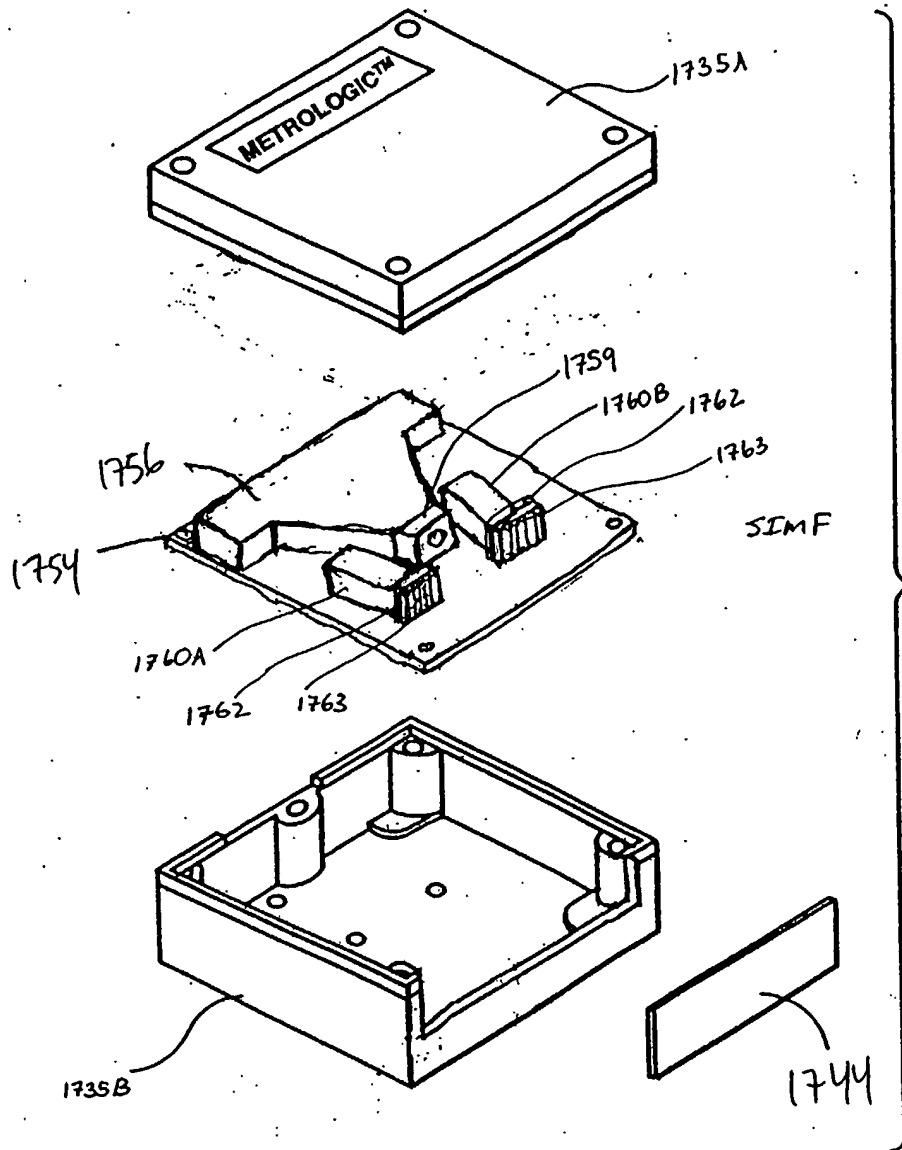


FIG. 49B

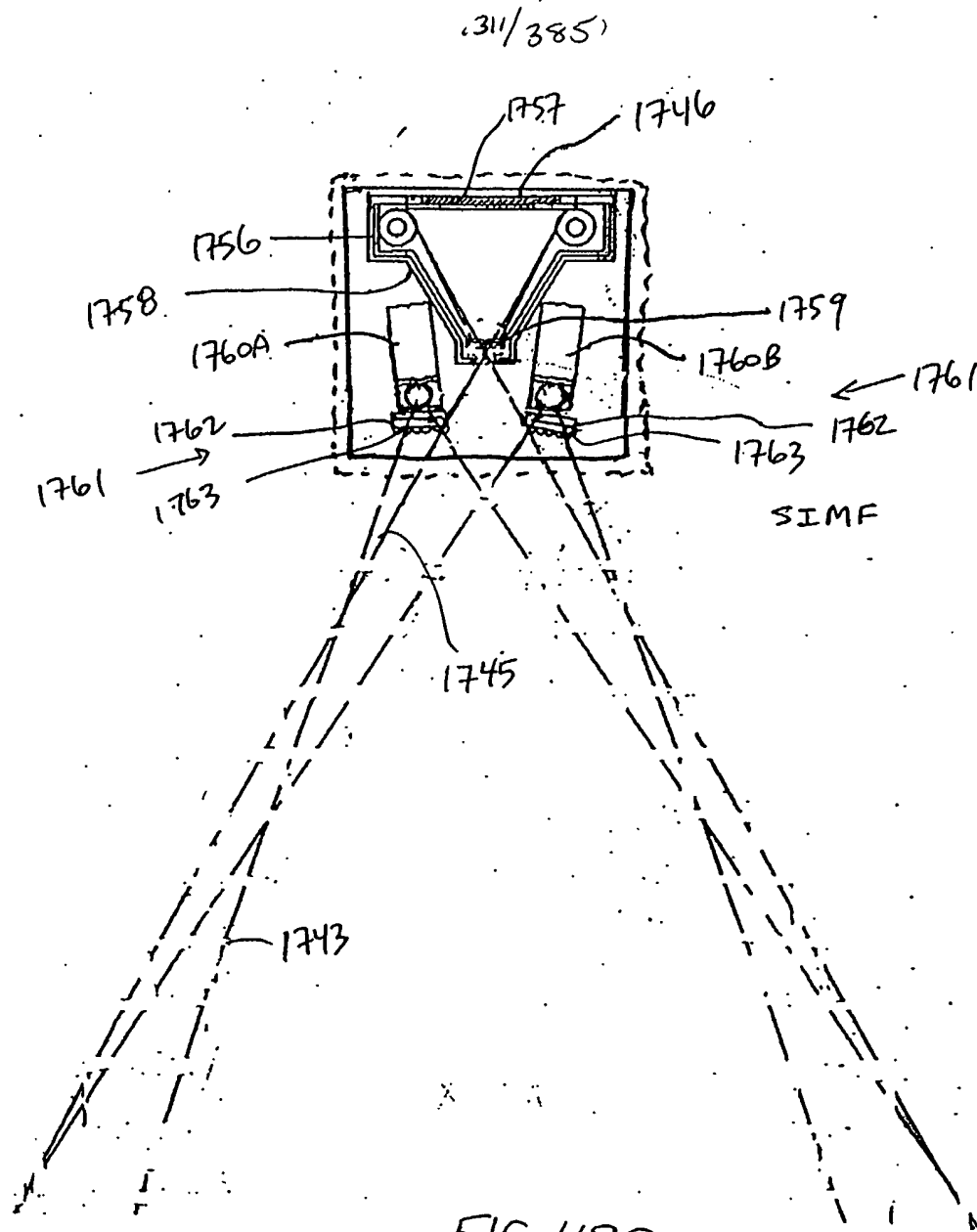
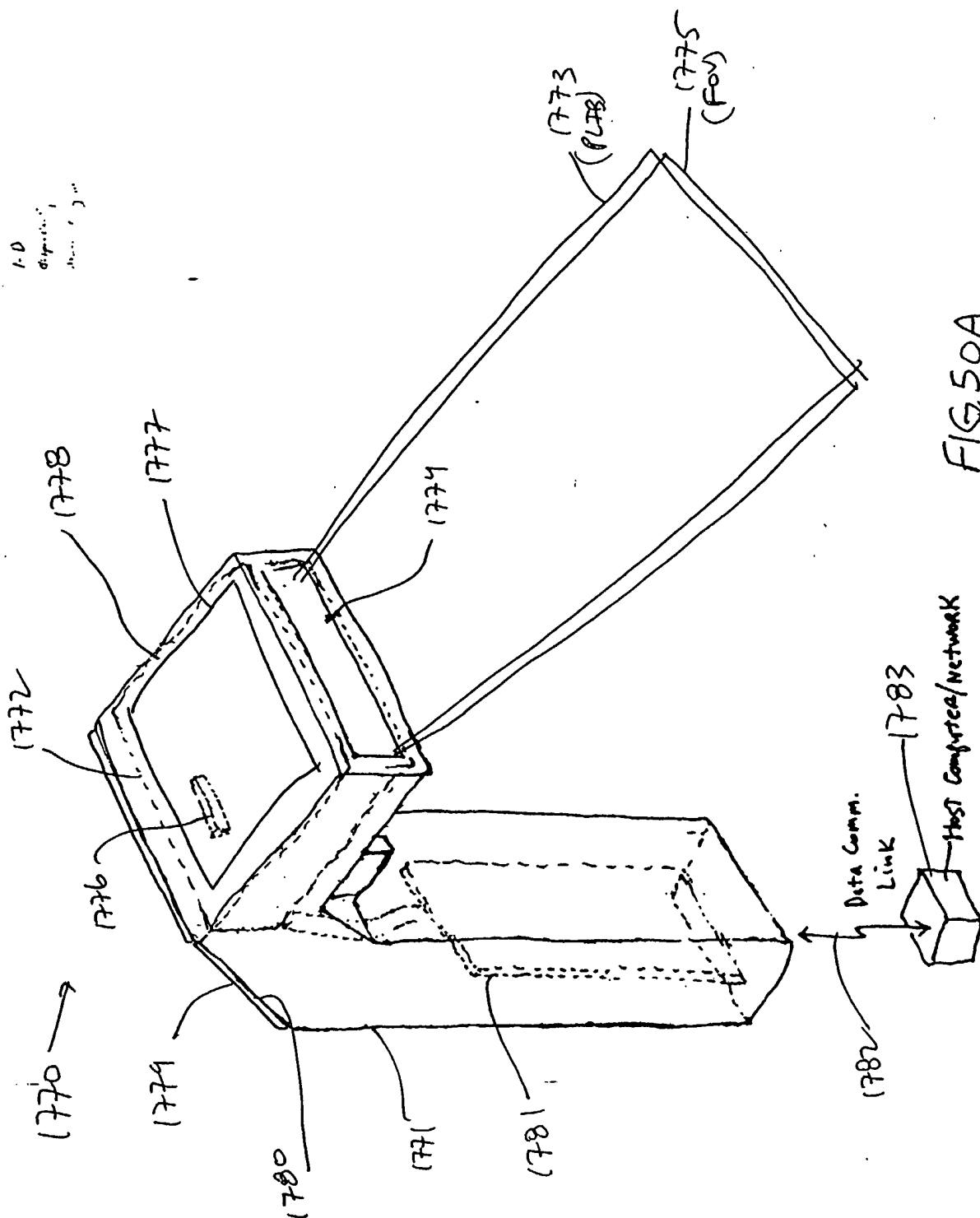


FIG. 49C

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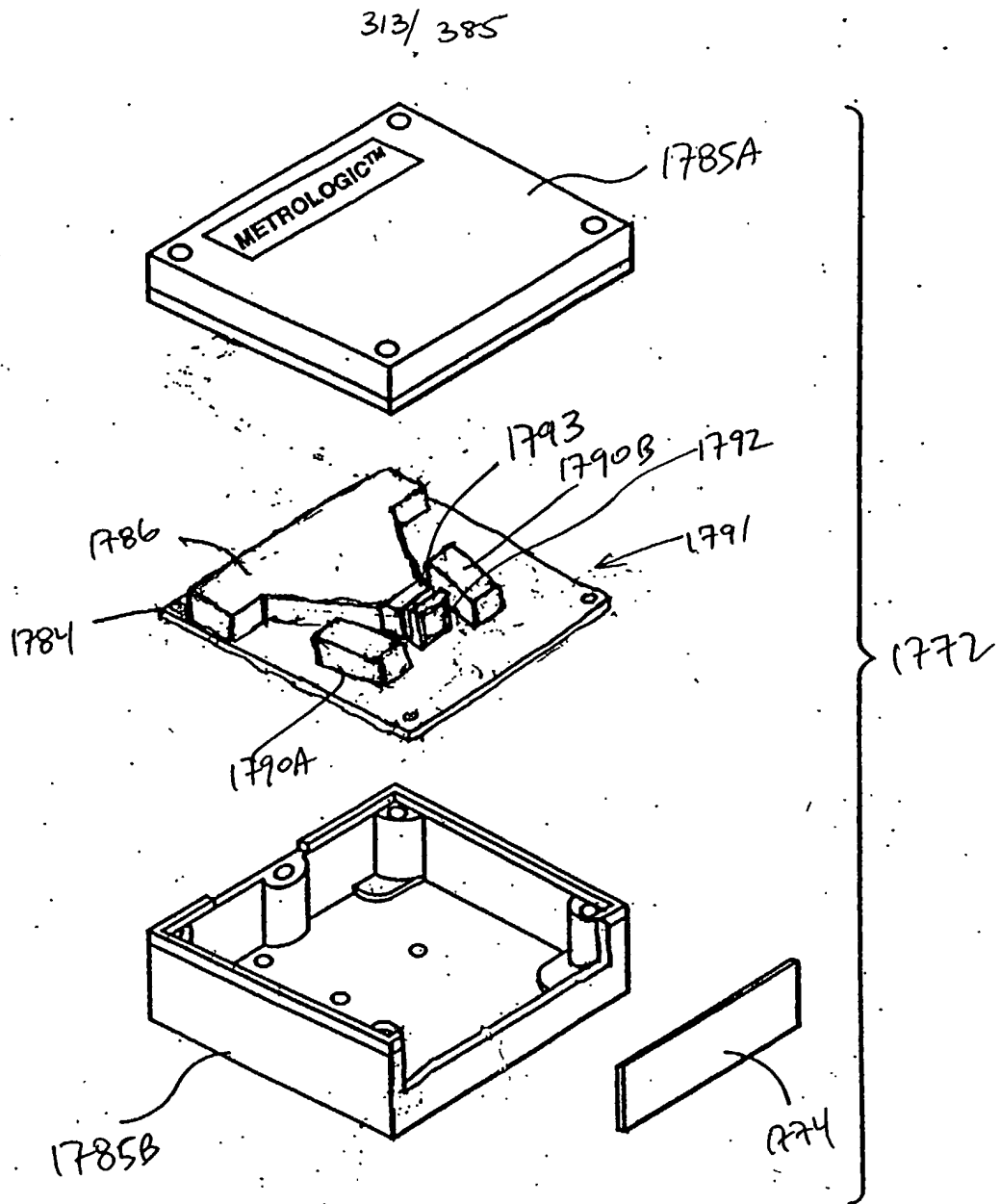


FIG. 50B

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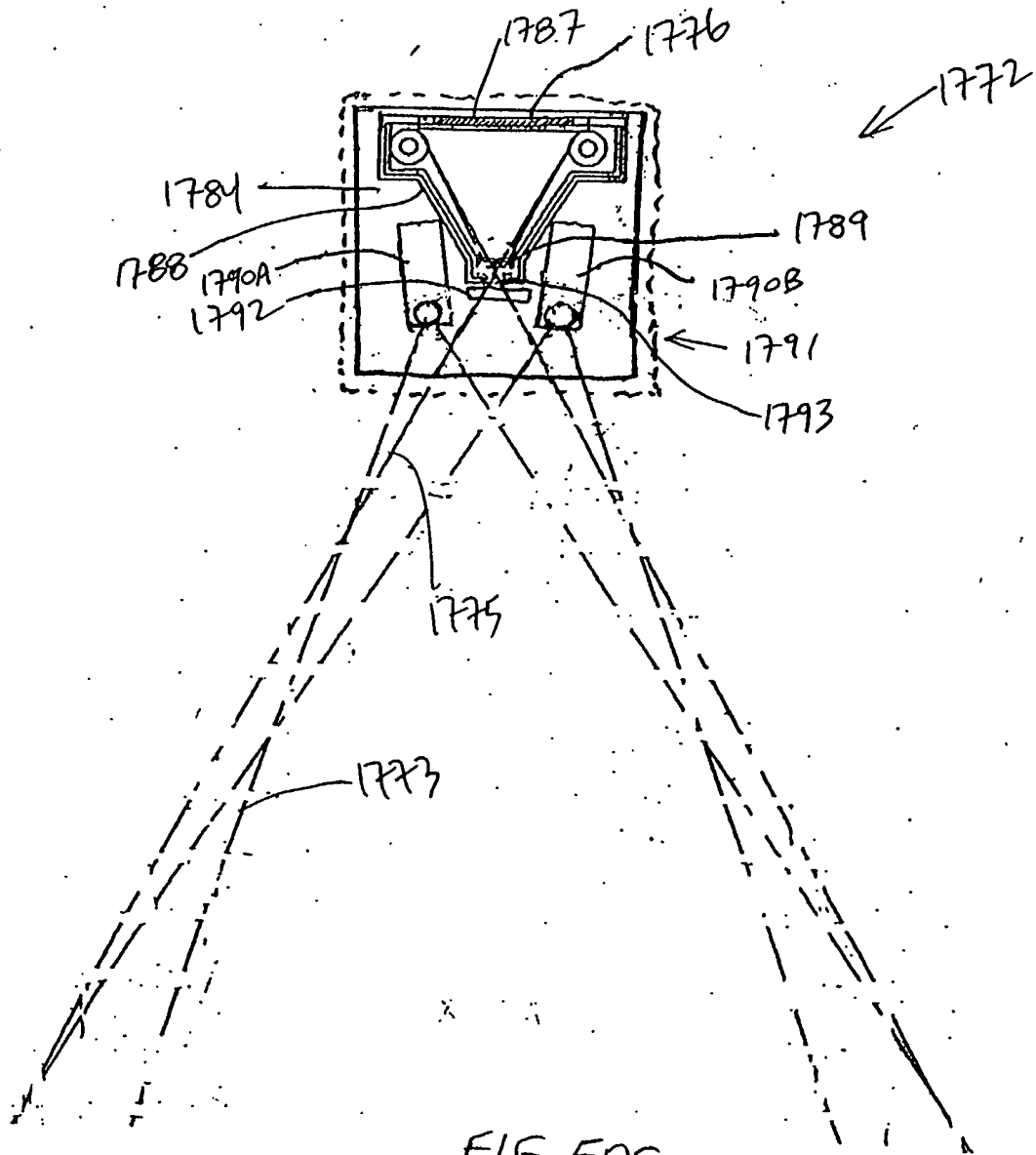
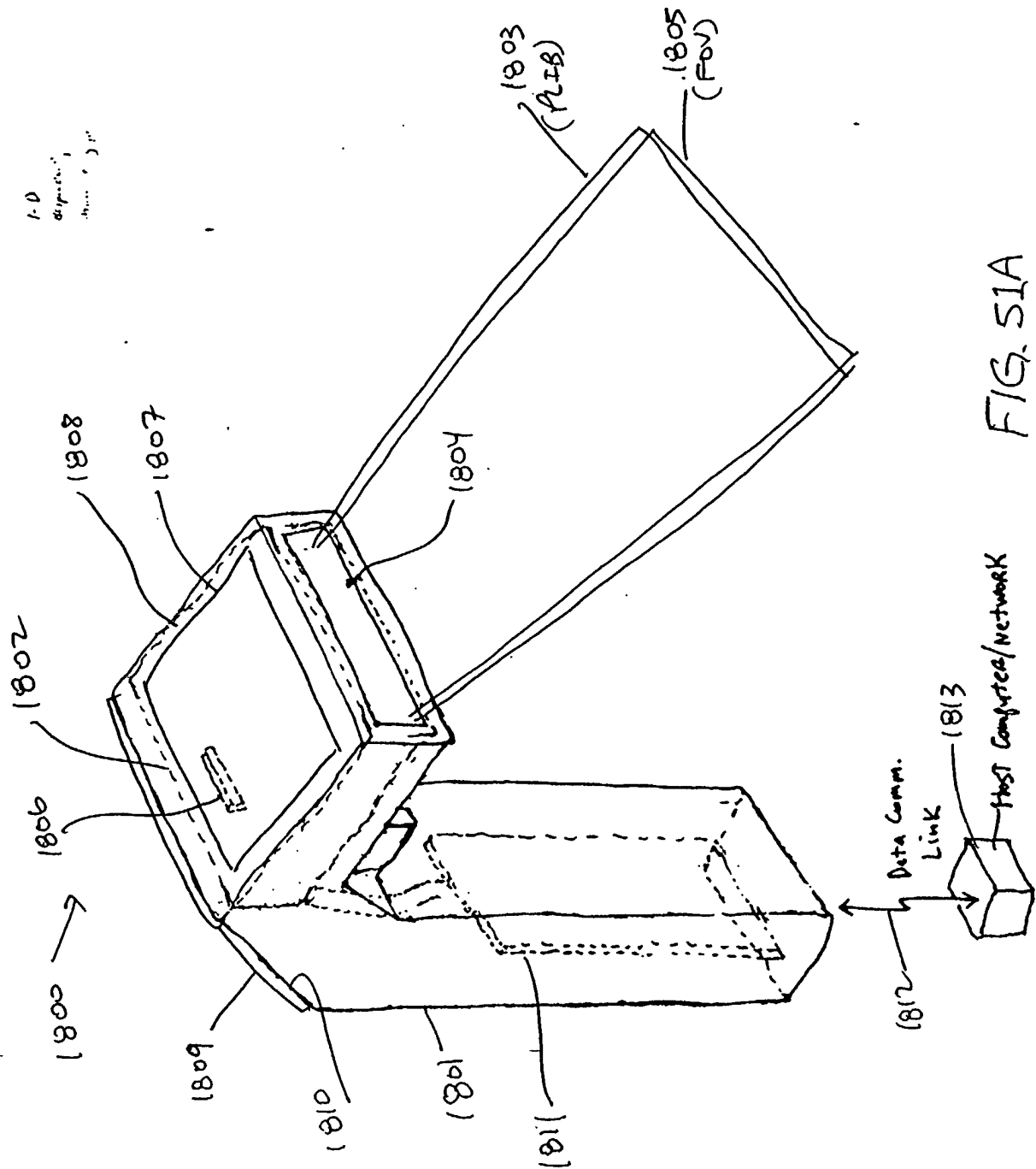


FIG. 50C

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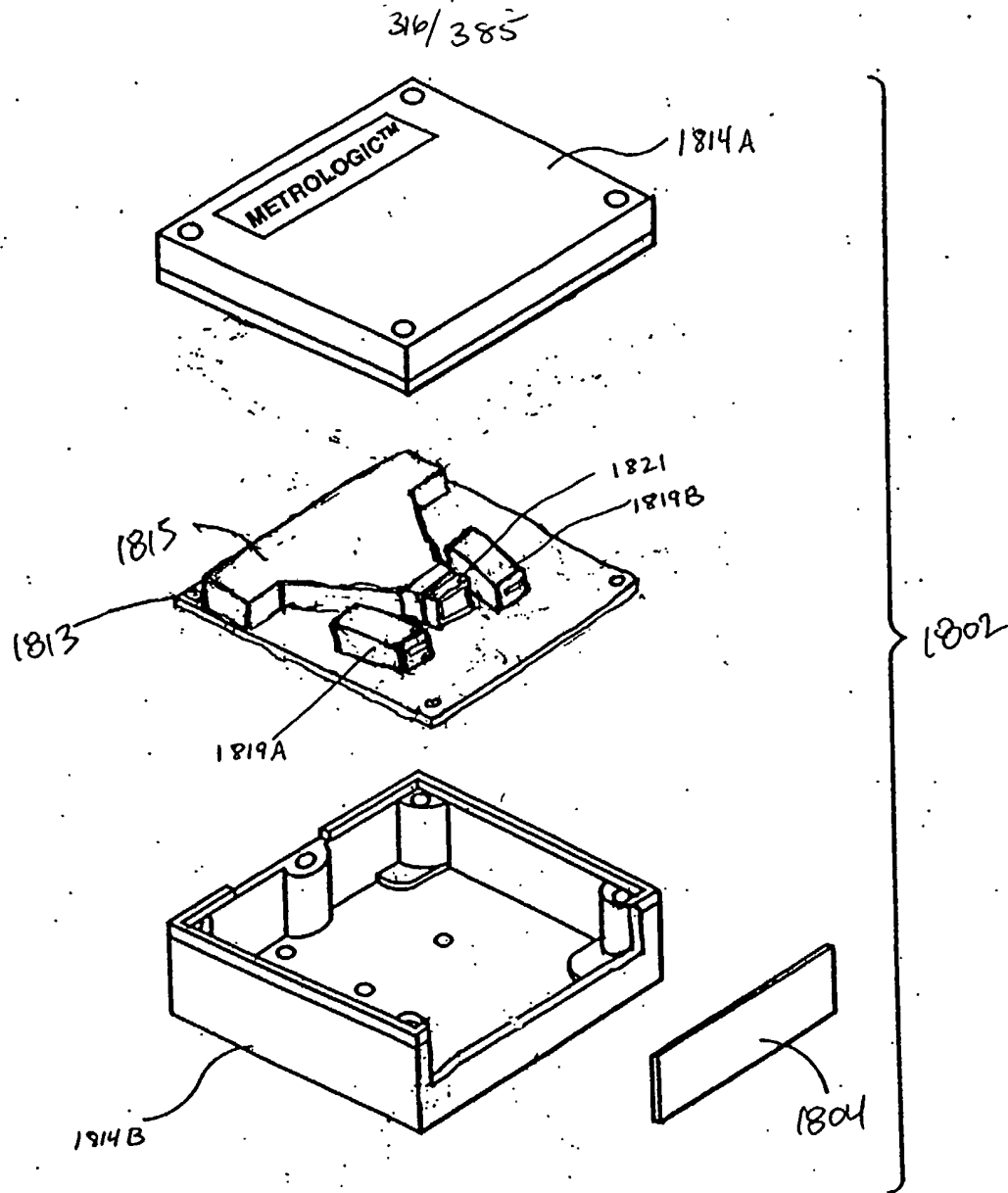
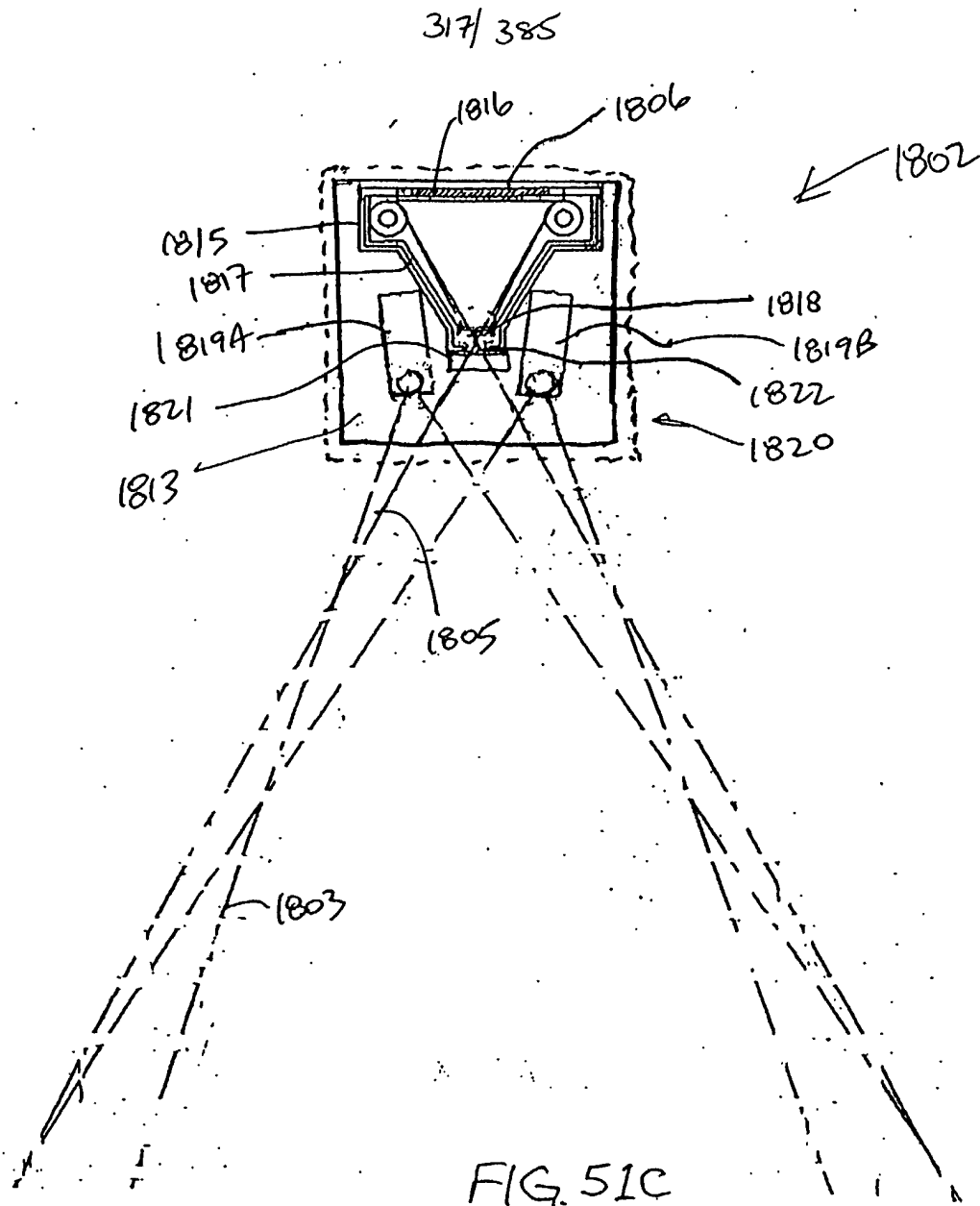


FIG. 51B



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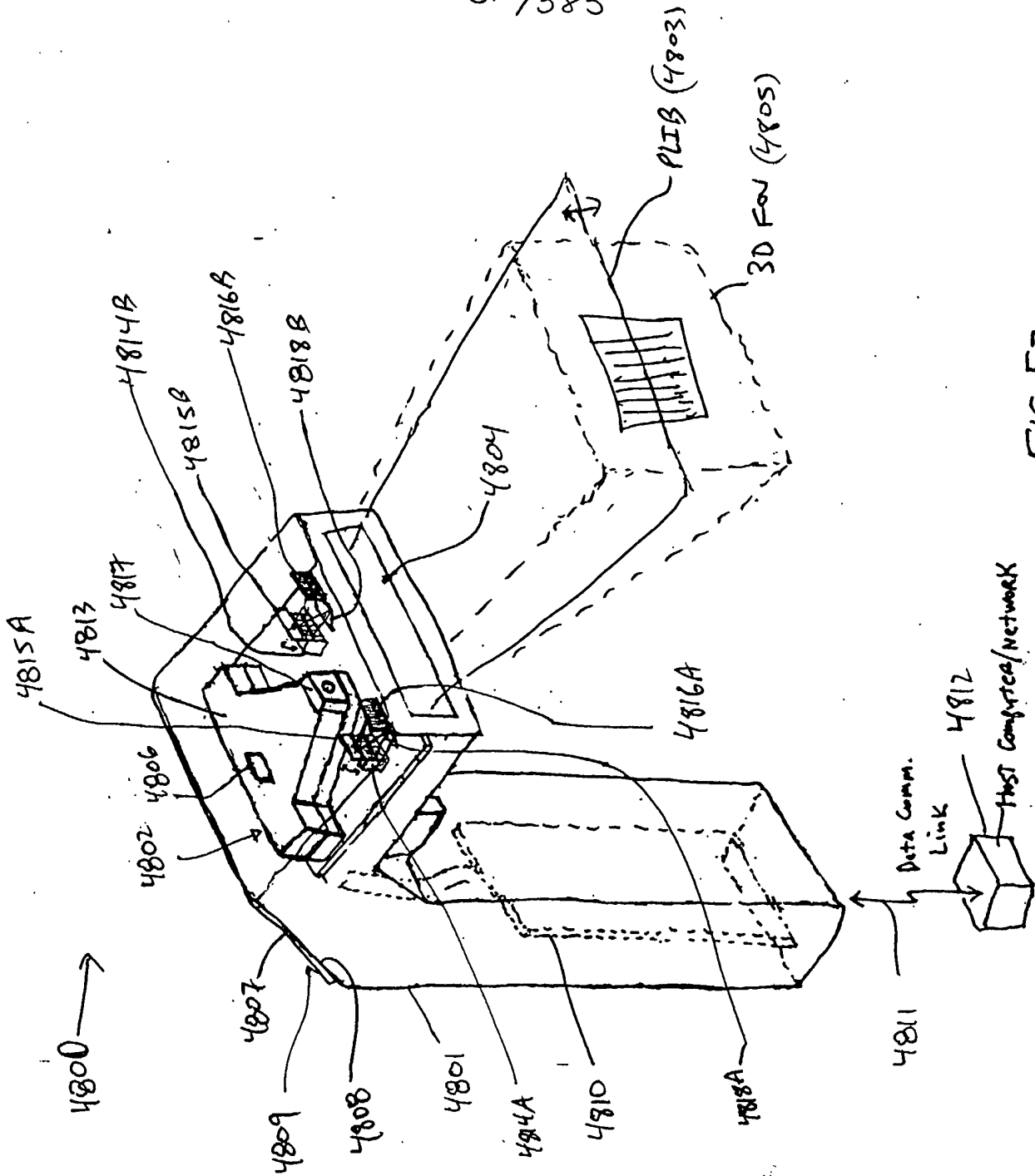


FIG. 52

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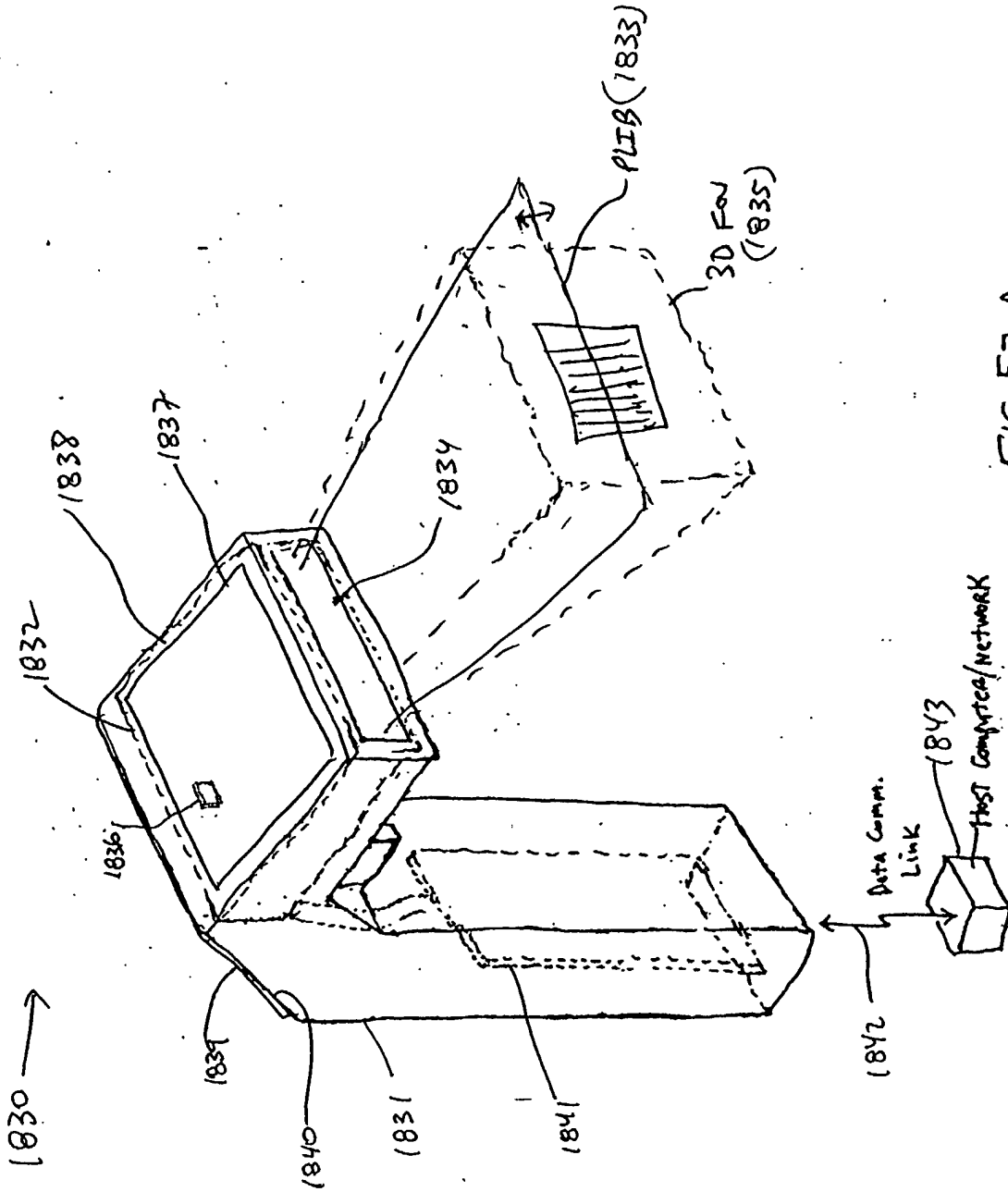


FIG. 52A

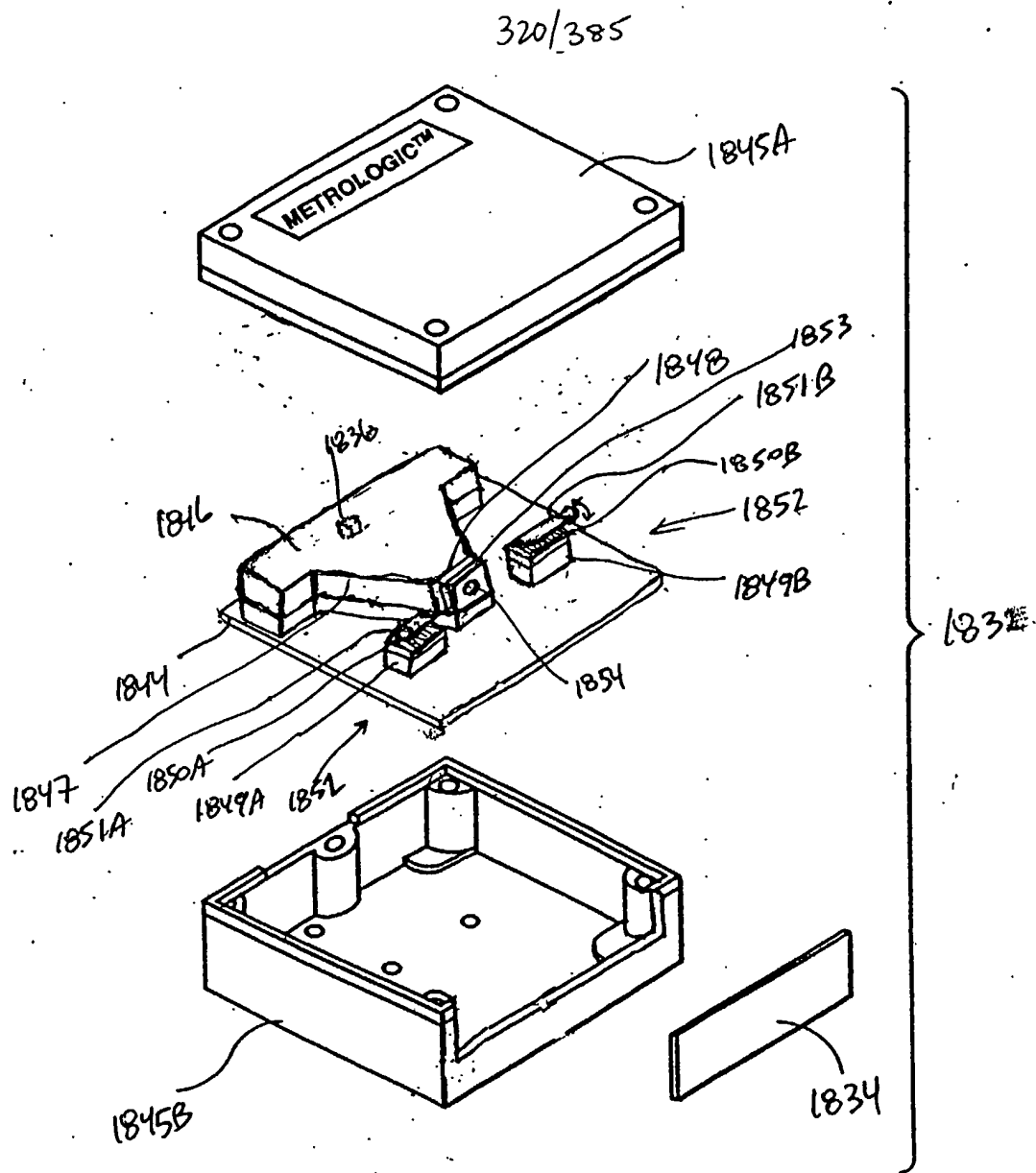


FIG. 52B

Fig. 1I 3A-3B

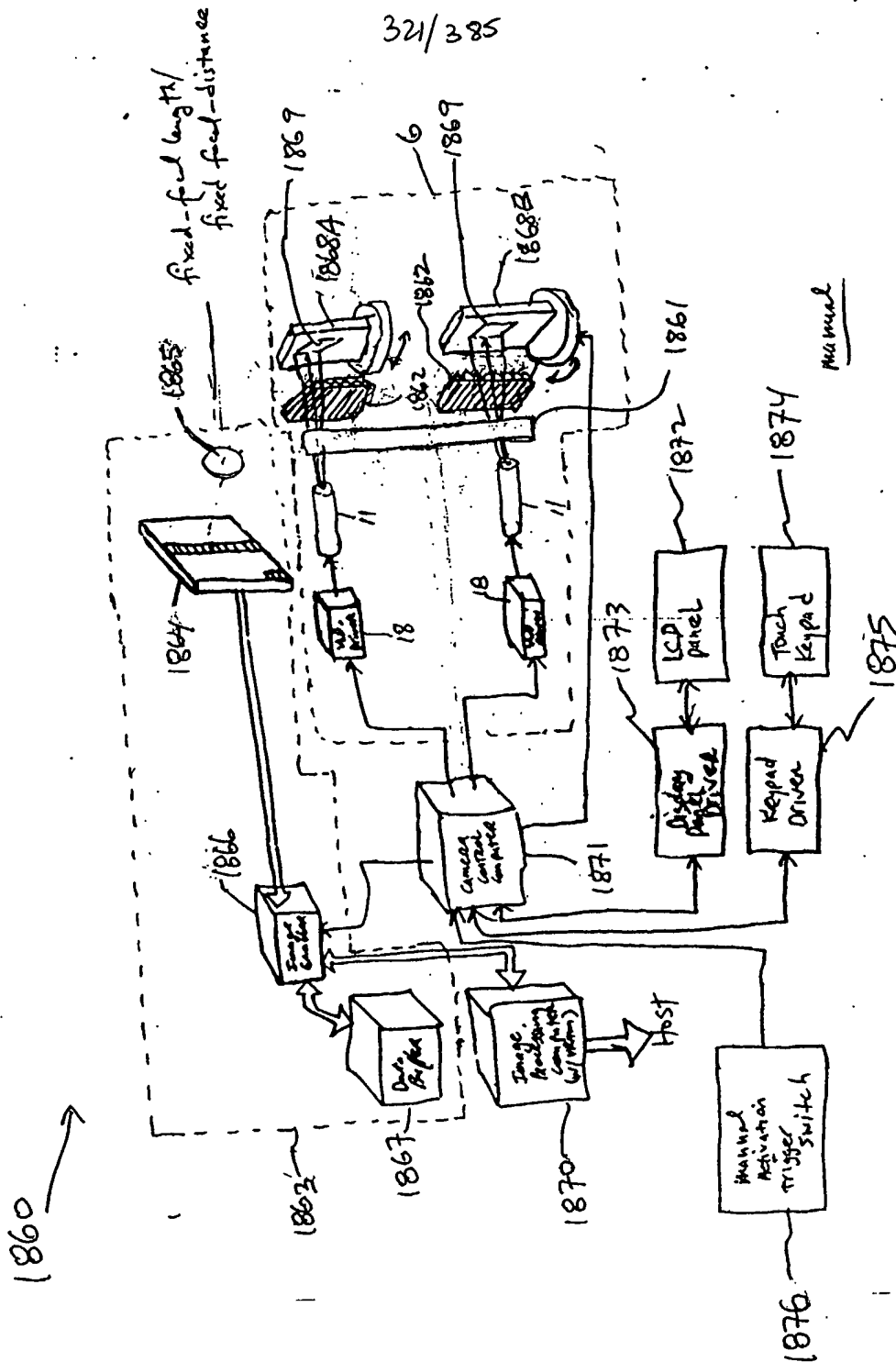


FIG. 53A1

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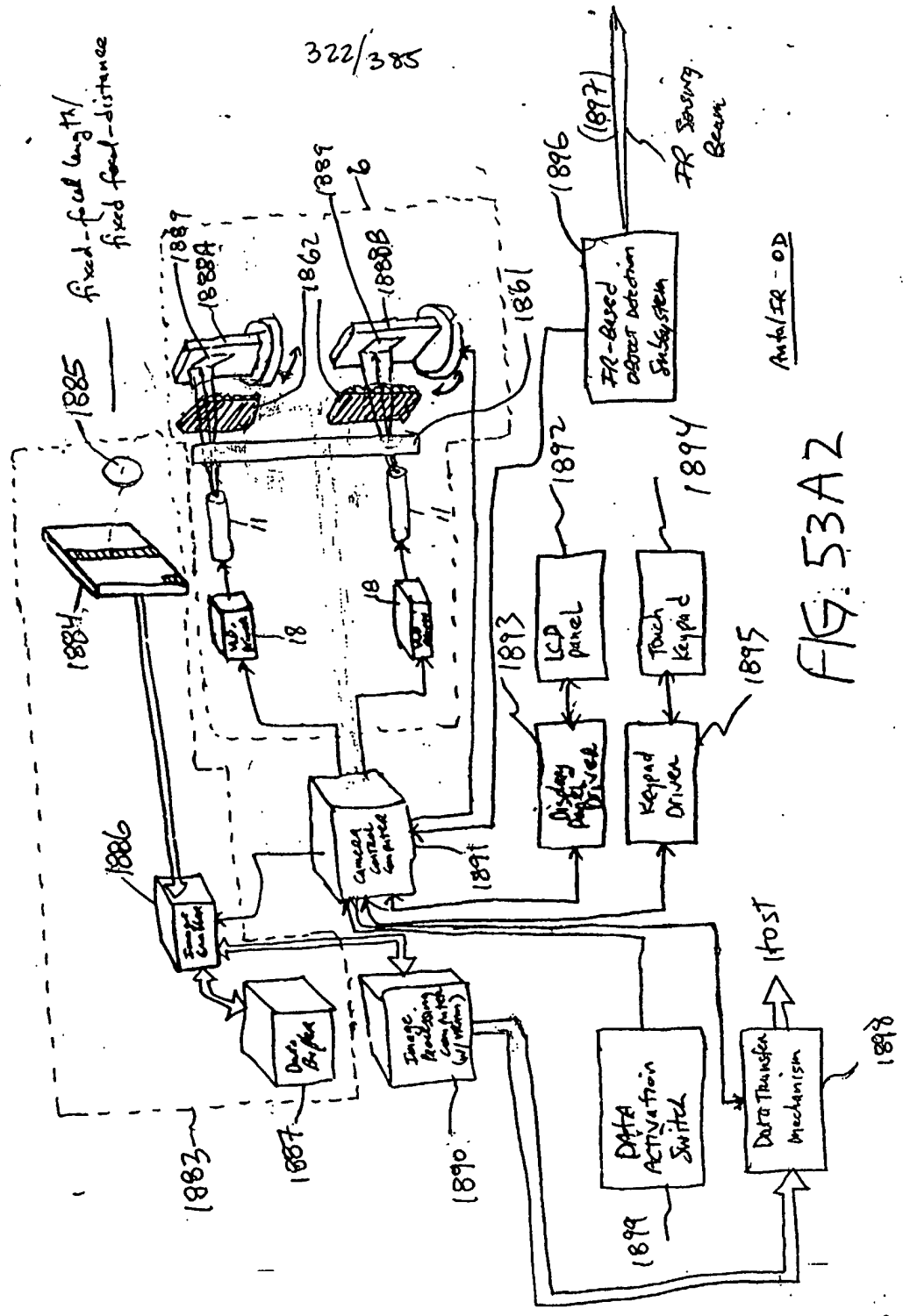
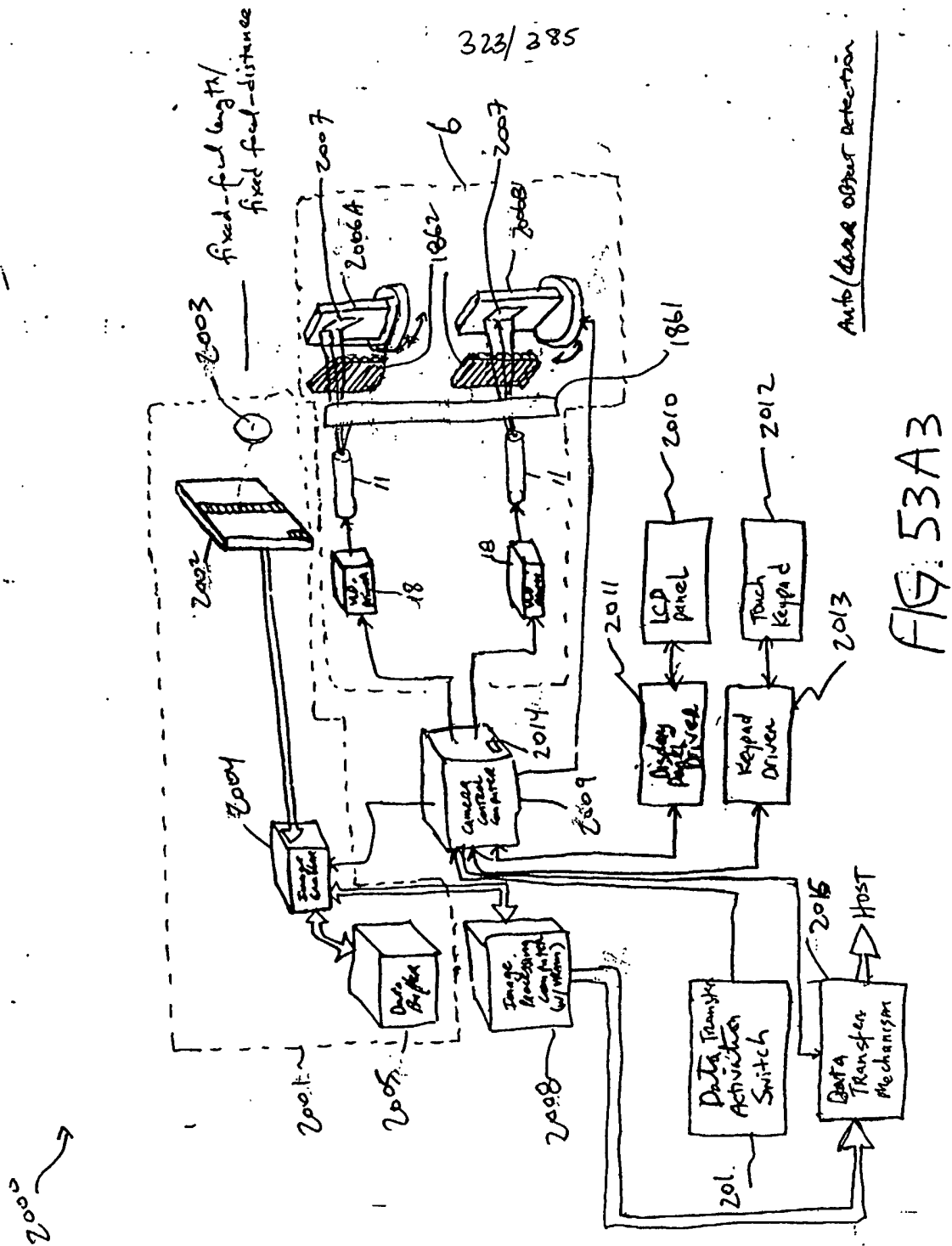


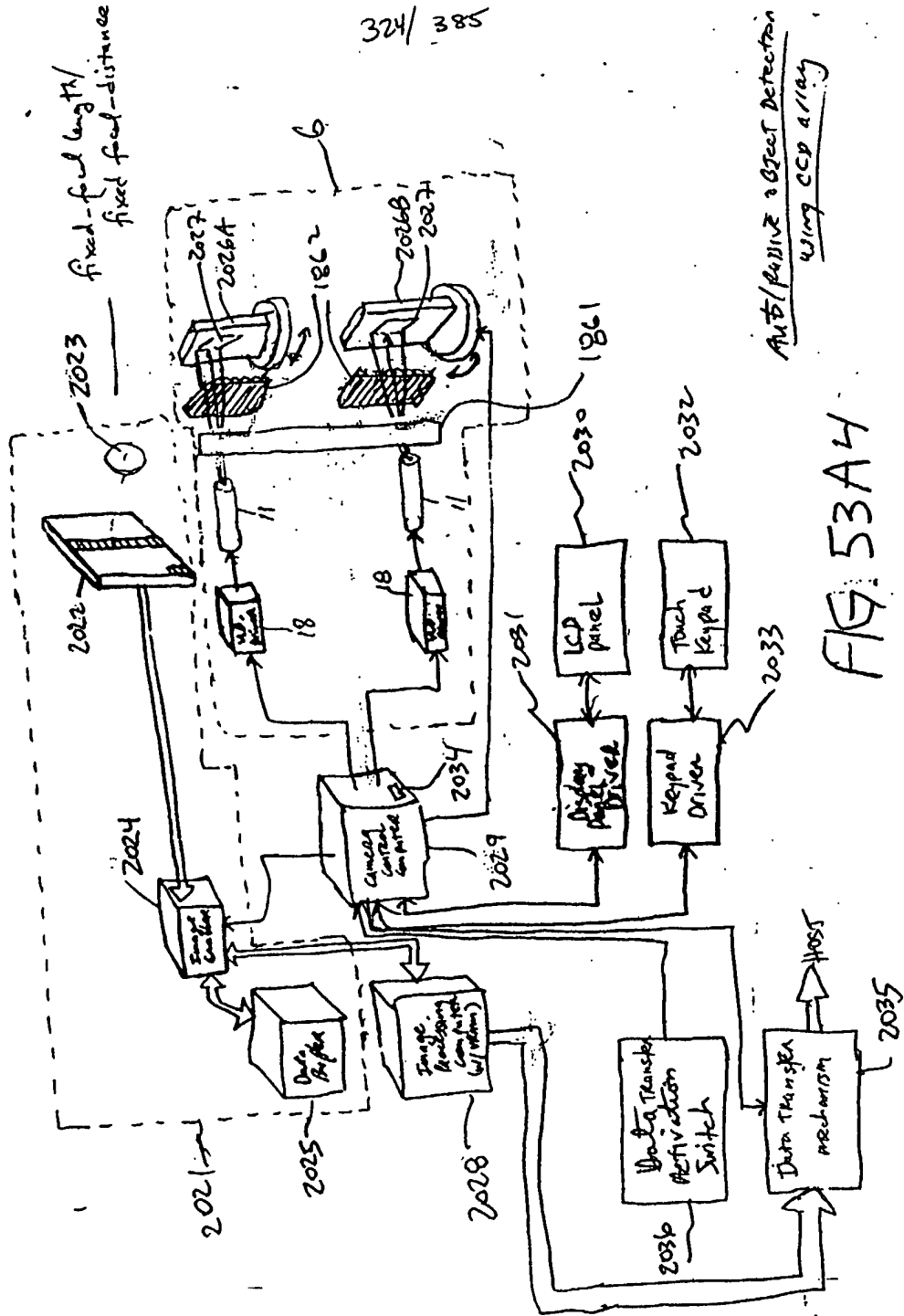
FIG. 53A2

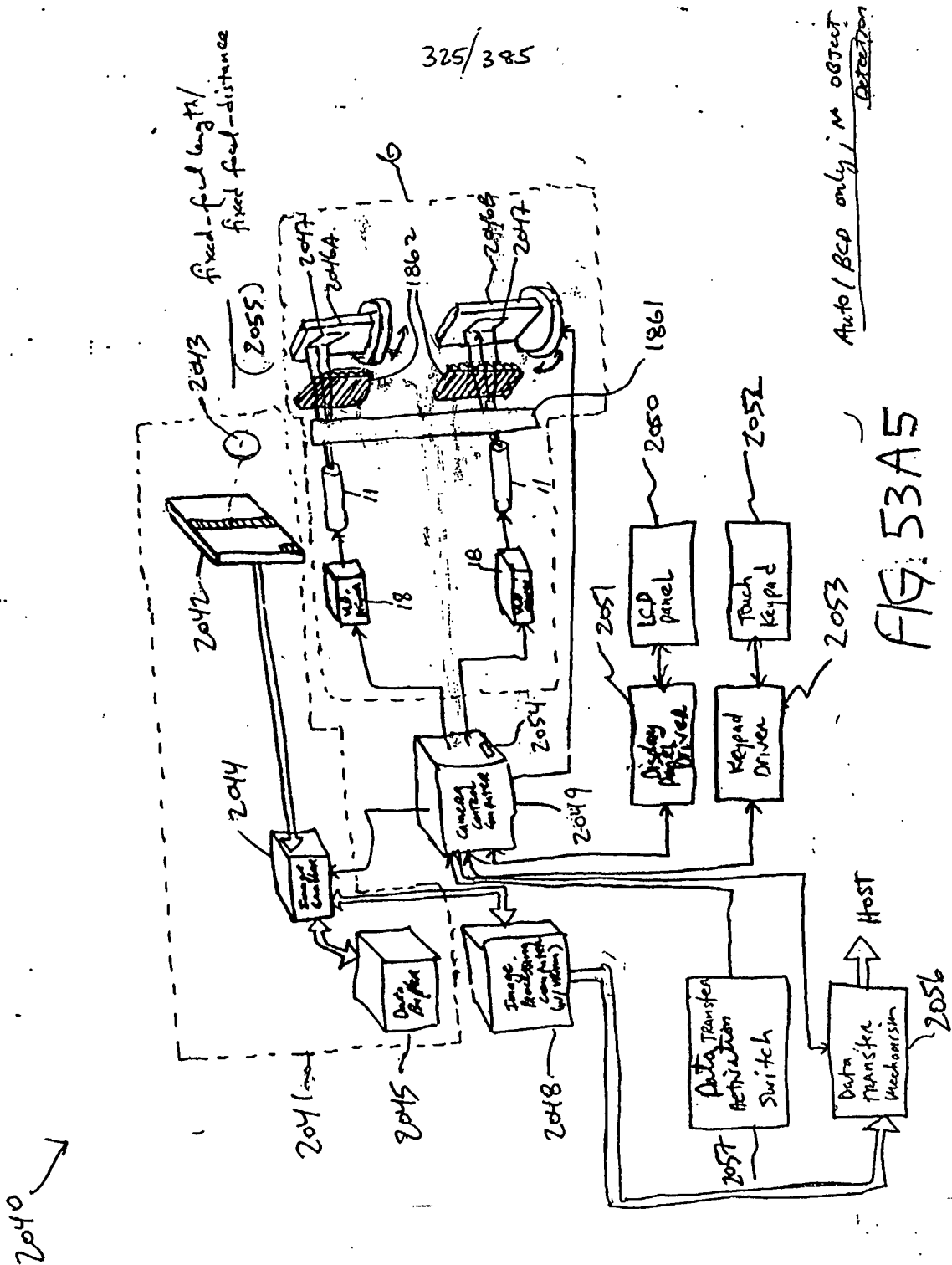
Auto/IR - OD

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2020 →





Auto / BCD only in object

FIG. 53A5

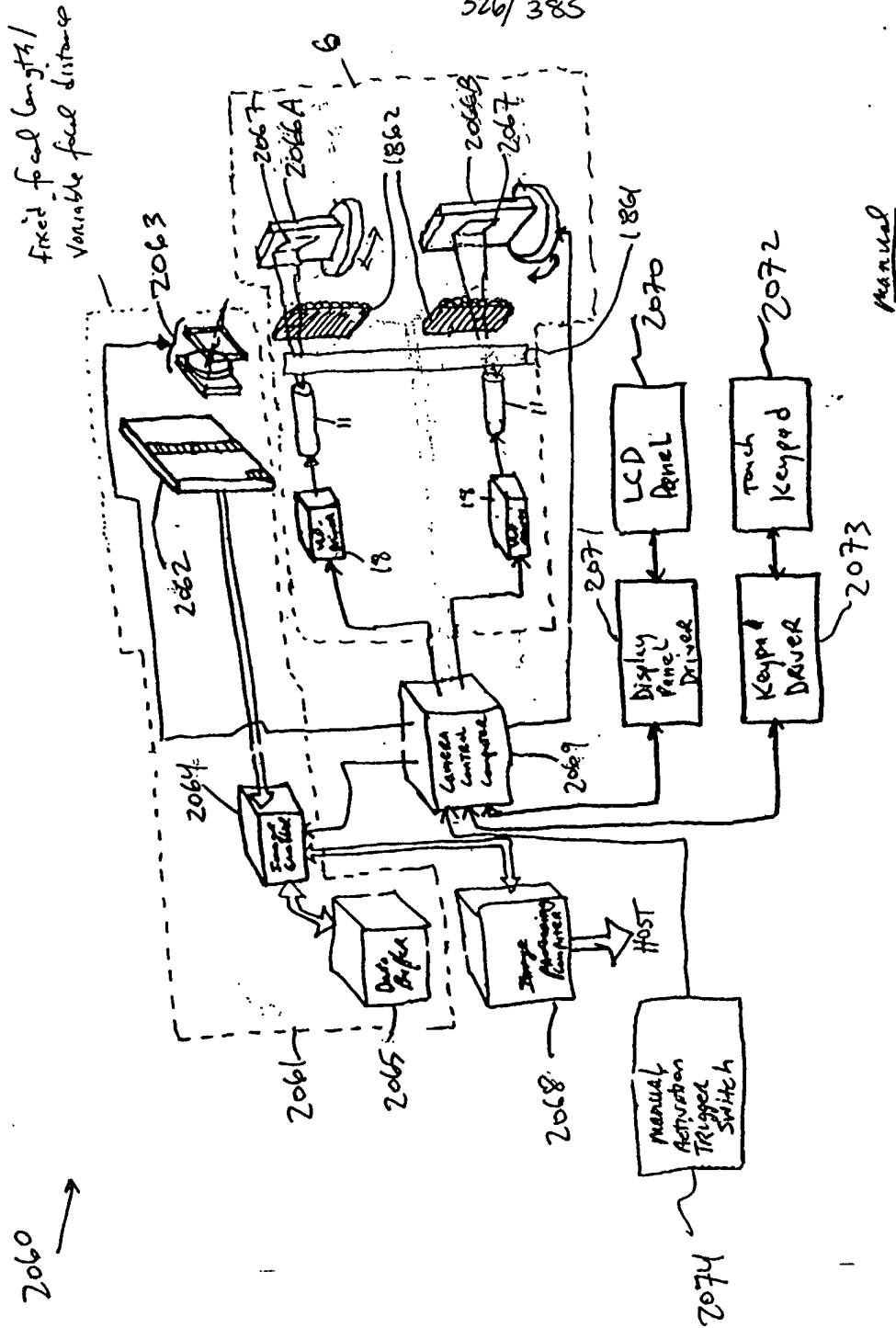
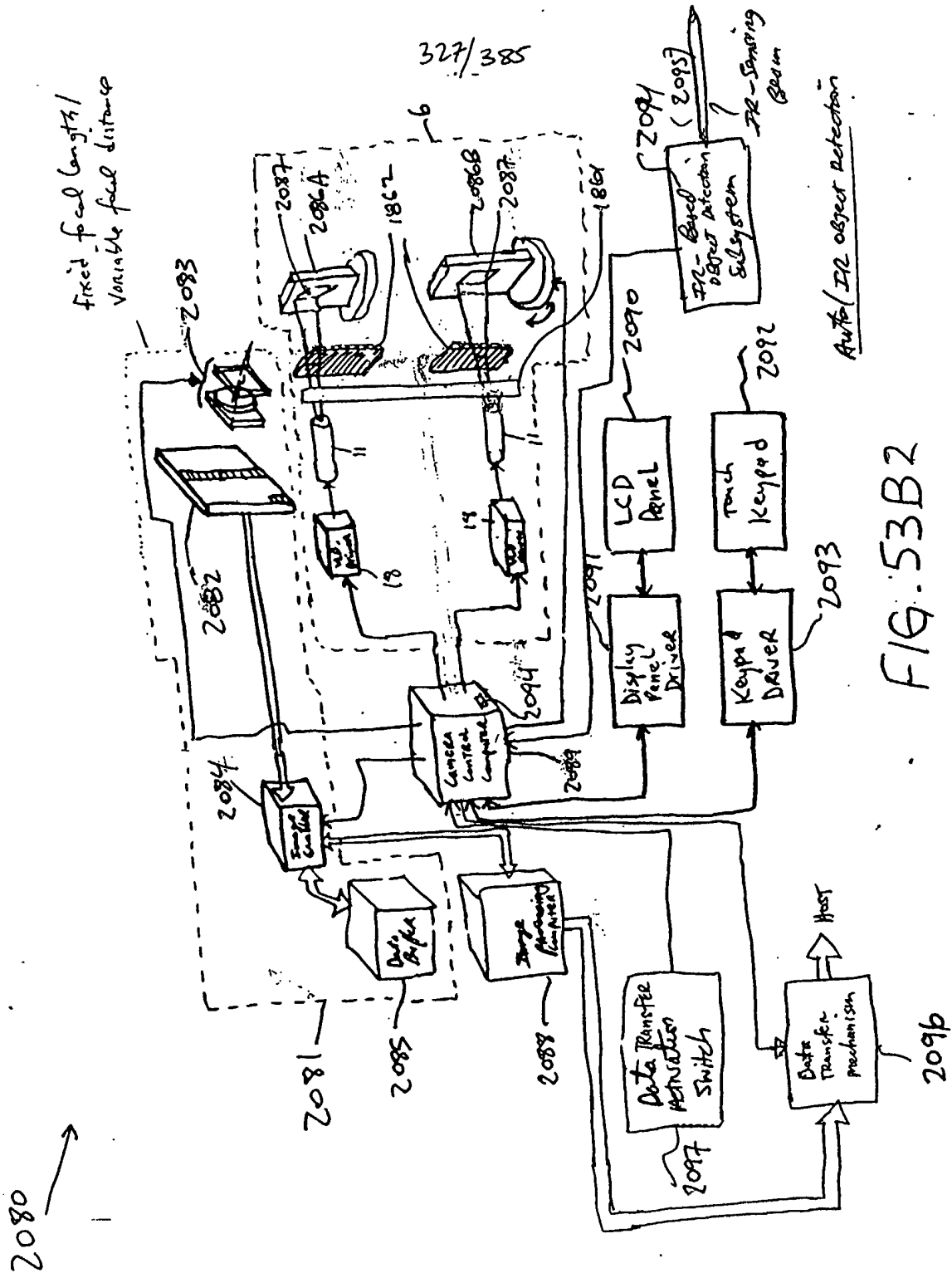
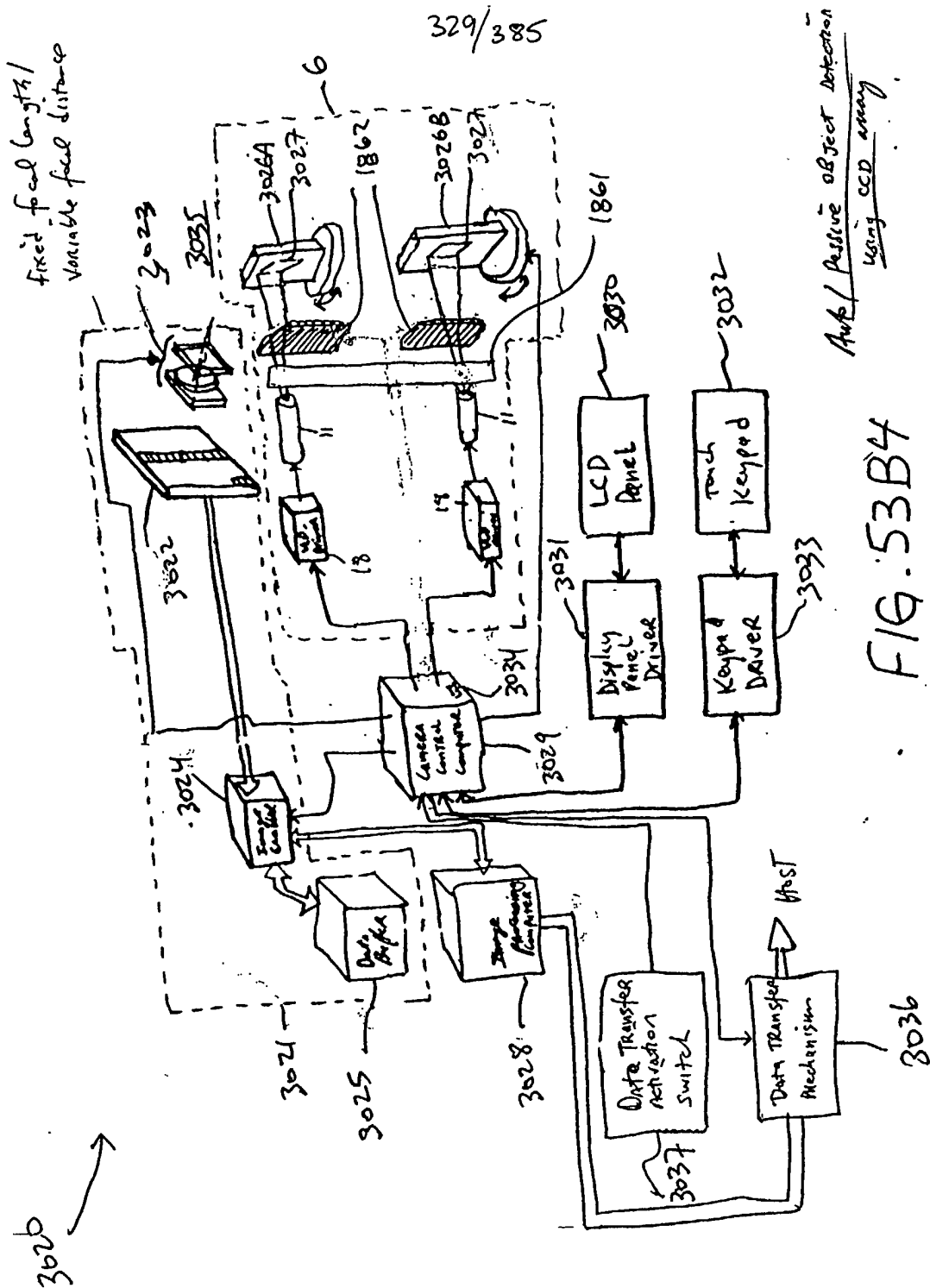
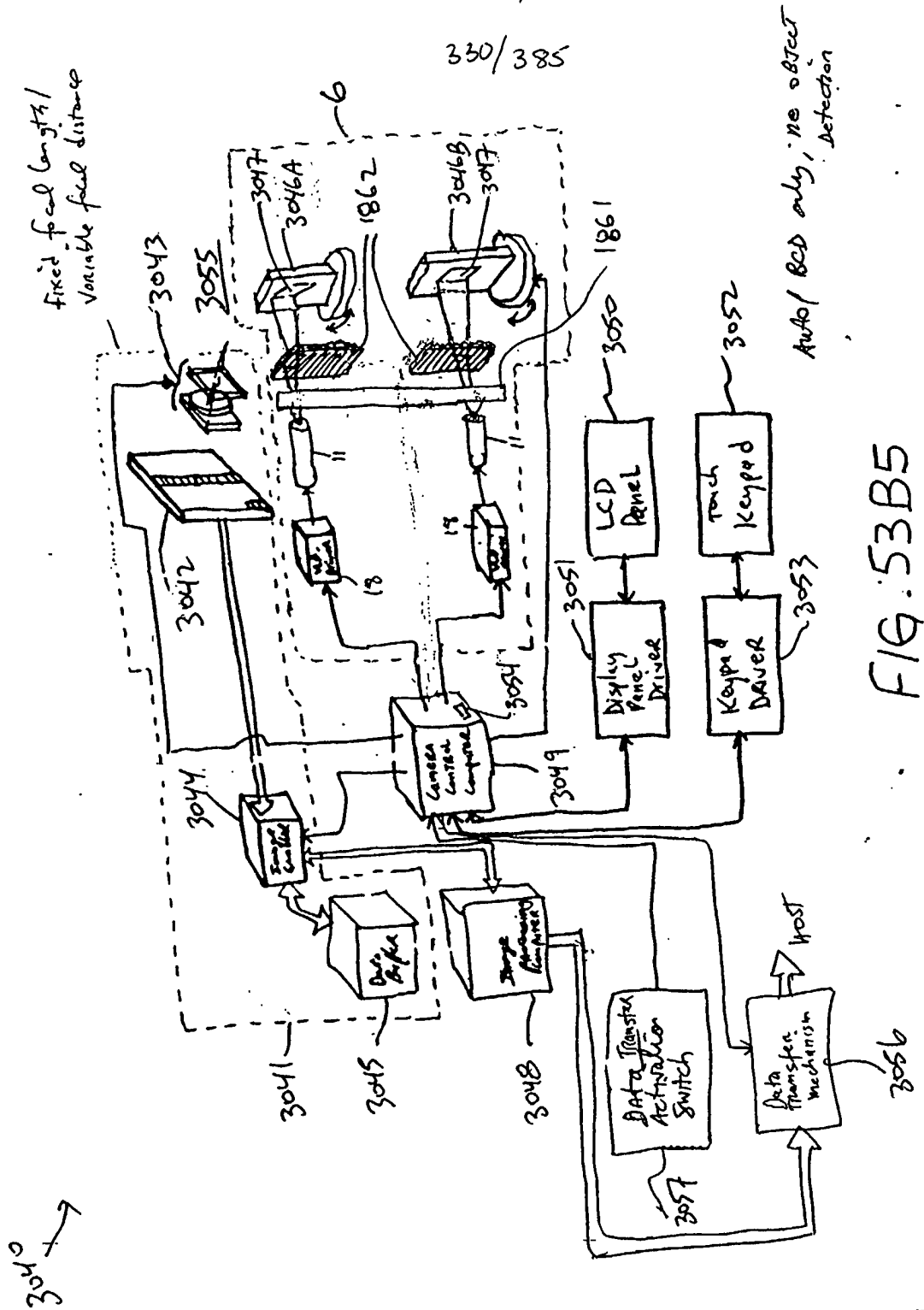


FIG. 53B1







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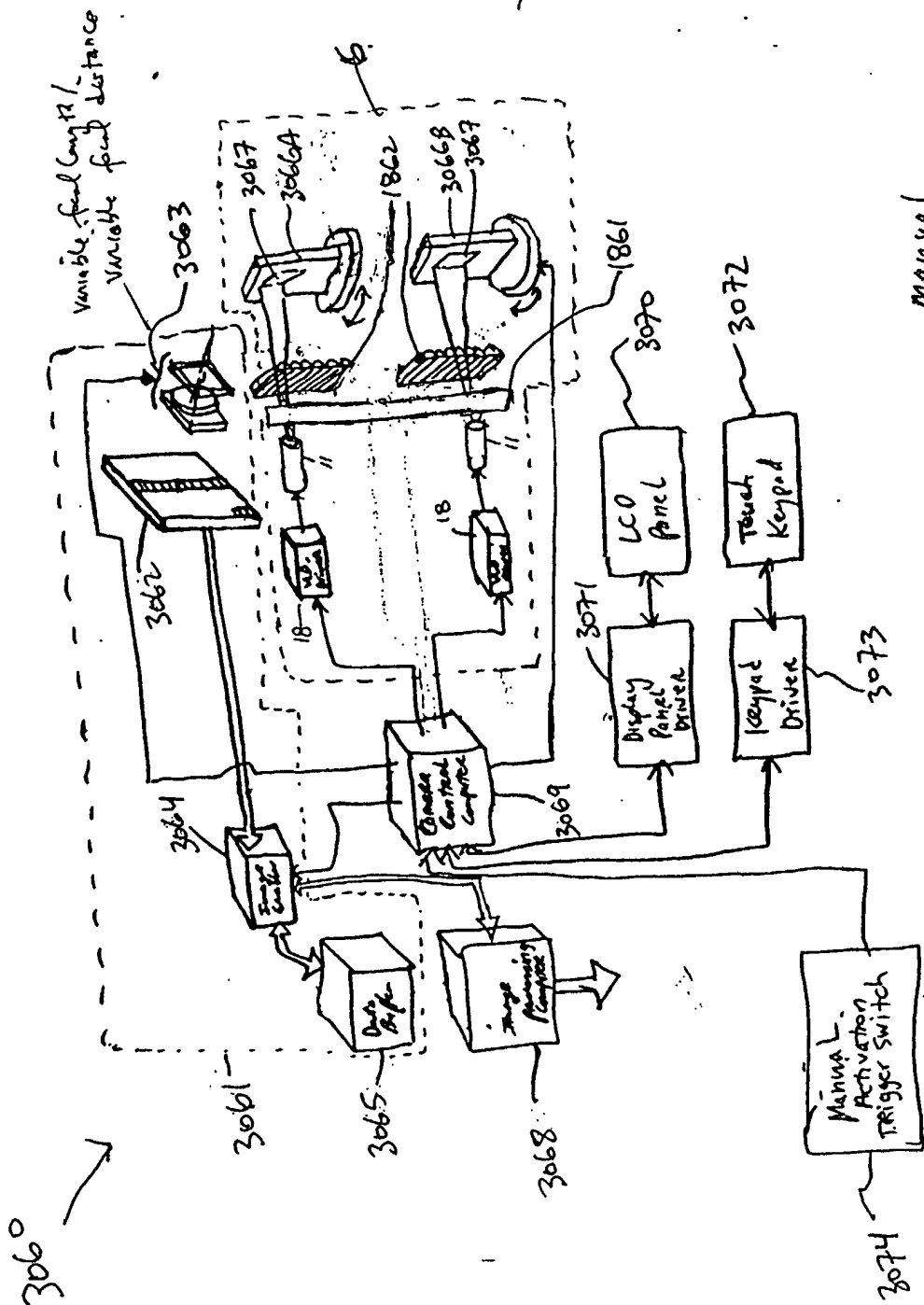
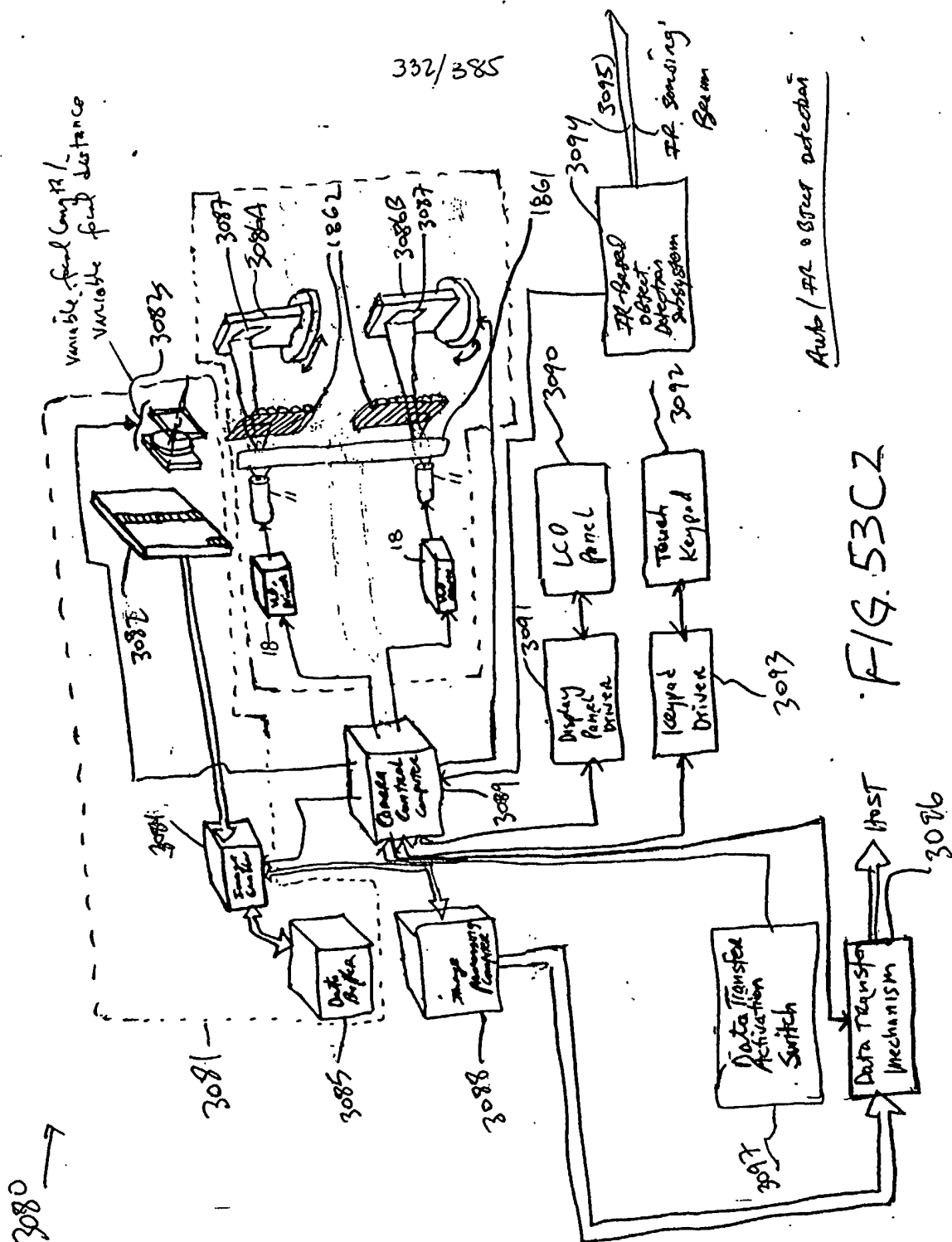
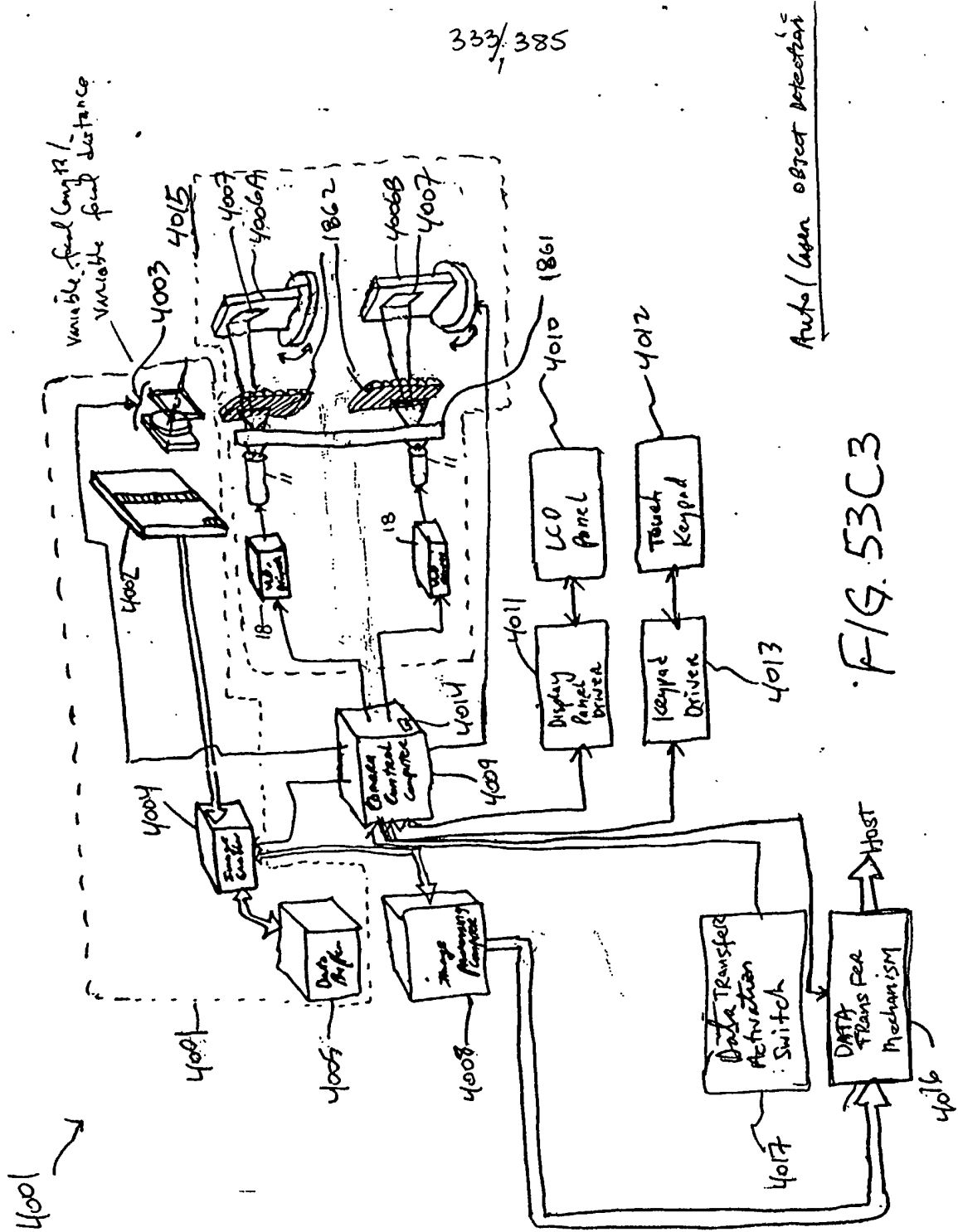


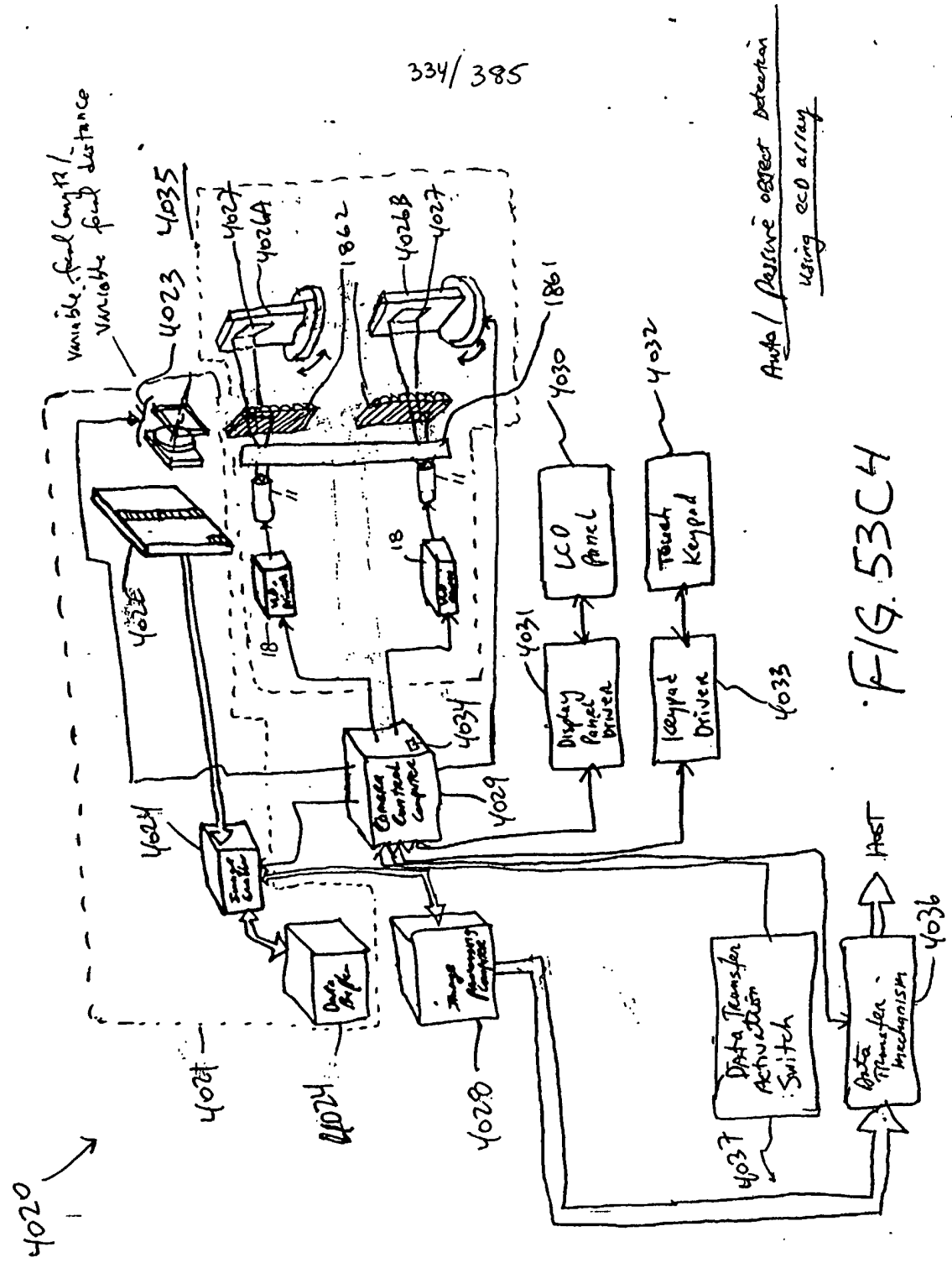
FIG. 53C1



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Auto / Passive object detection
using CCD array

FIG. 53C4

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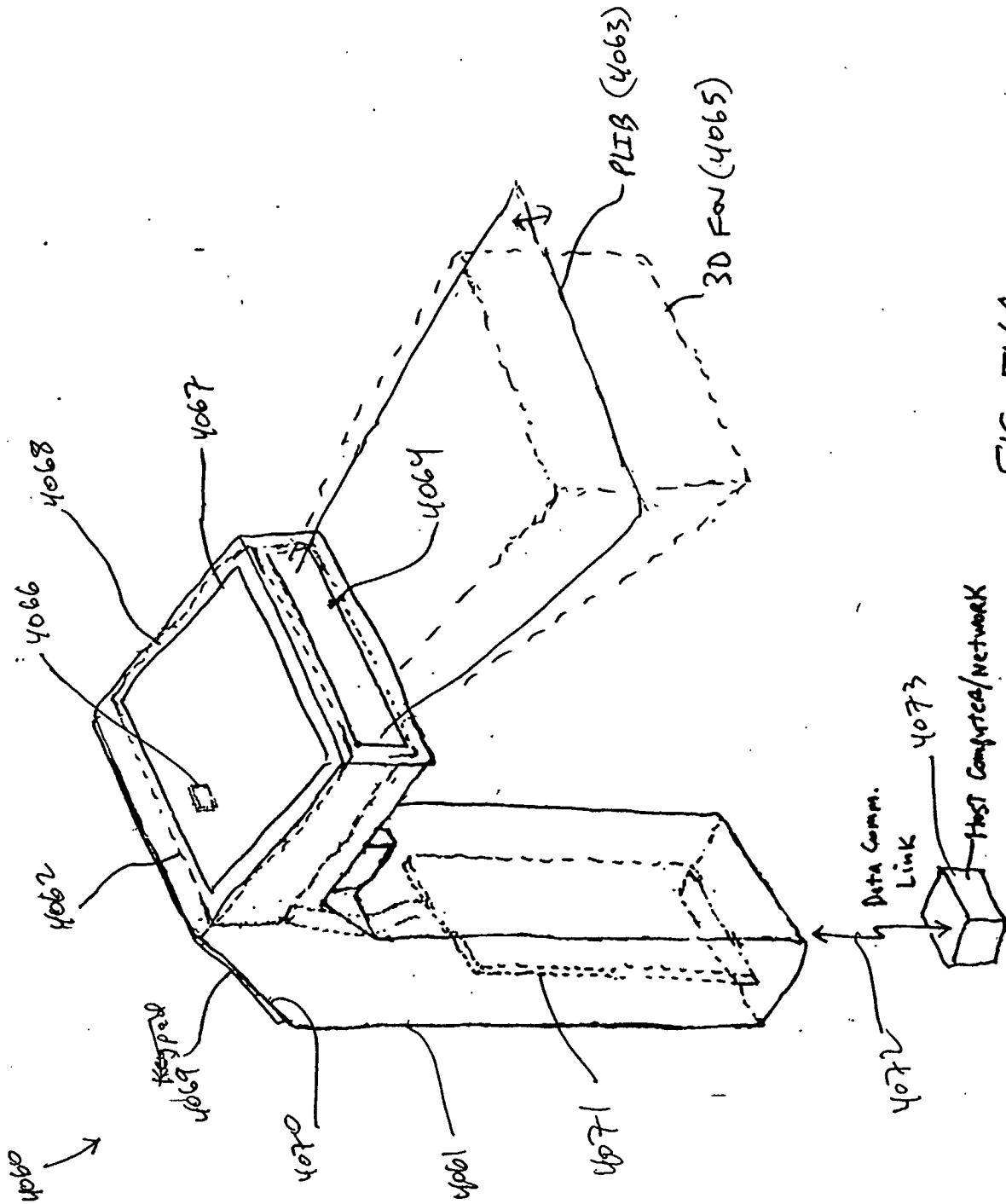


FIG. 54A

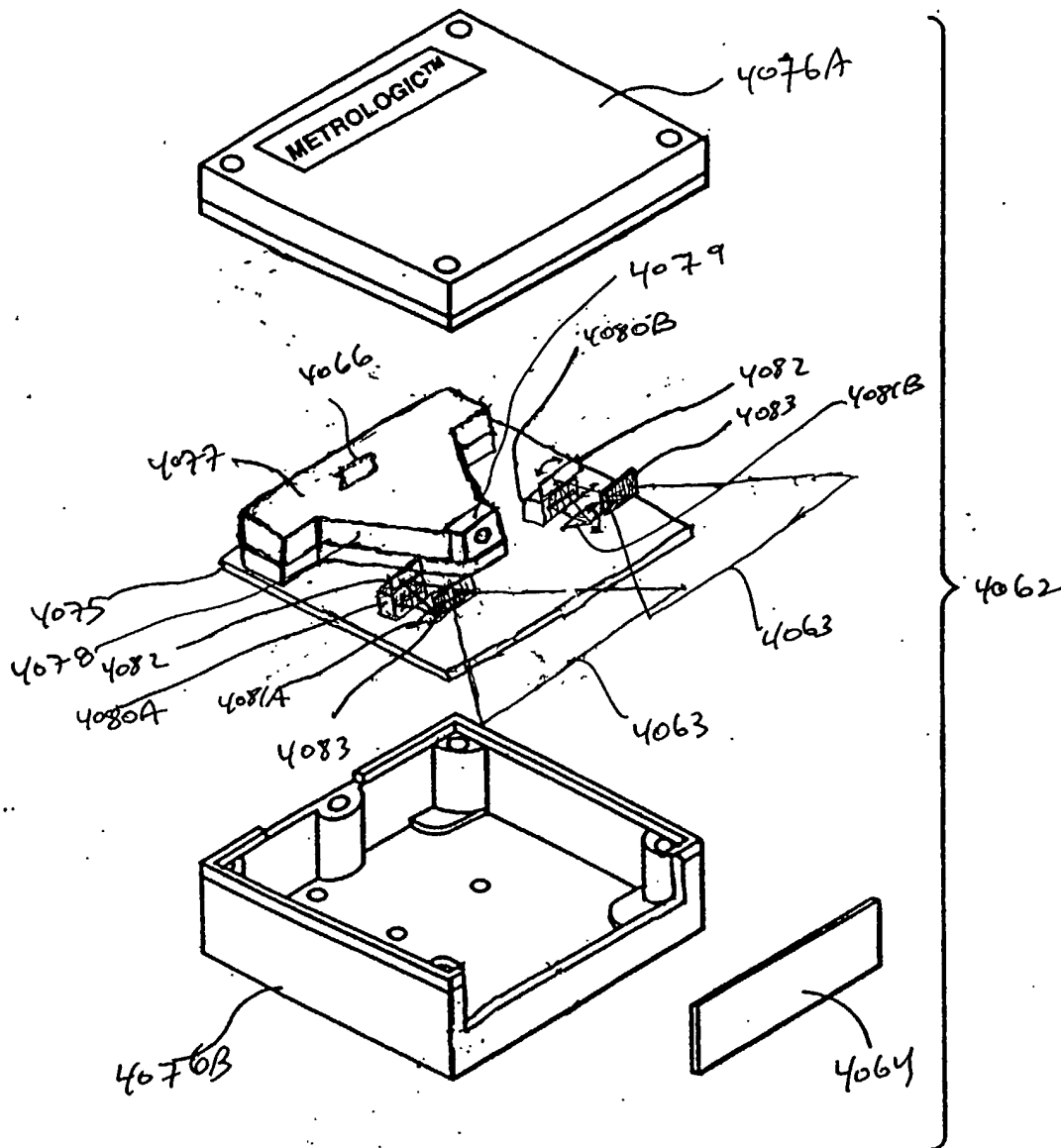
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FIG. 54B

(dual mirrors)

Fig. 175A-5P1

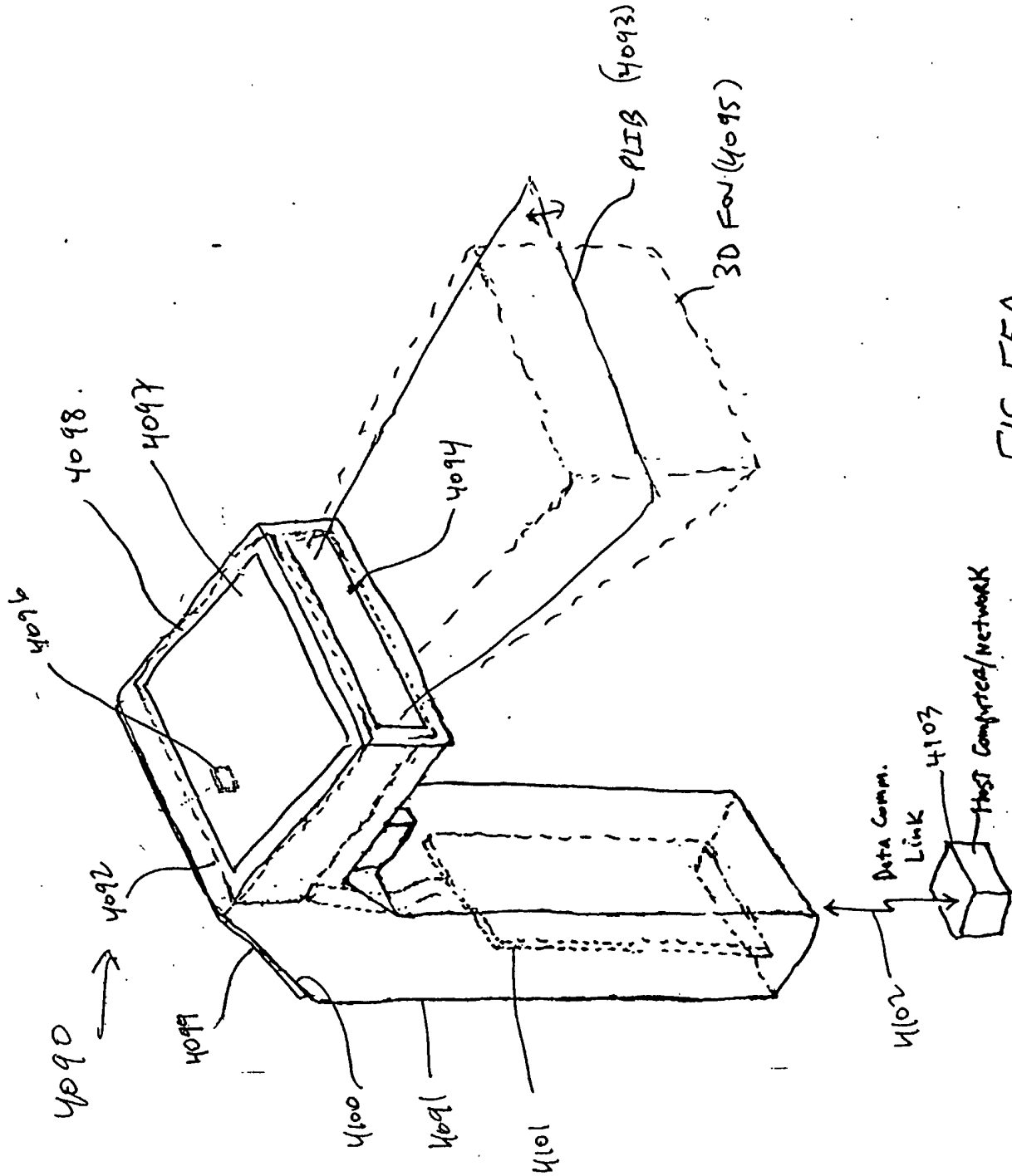


FIG. 55A

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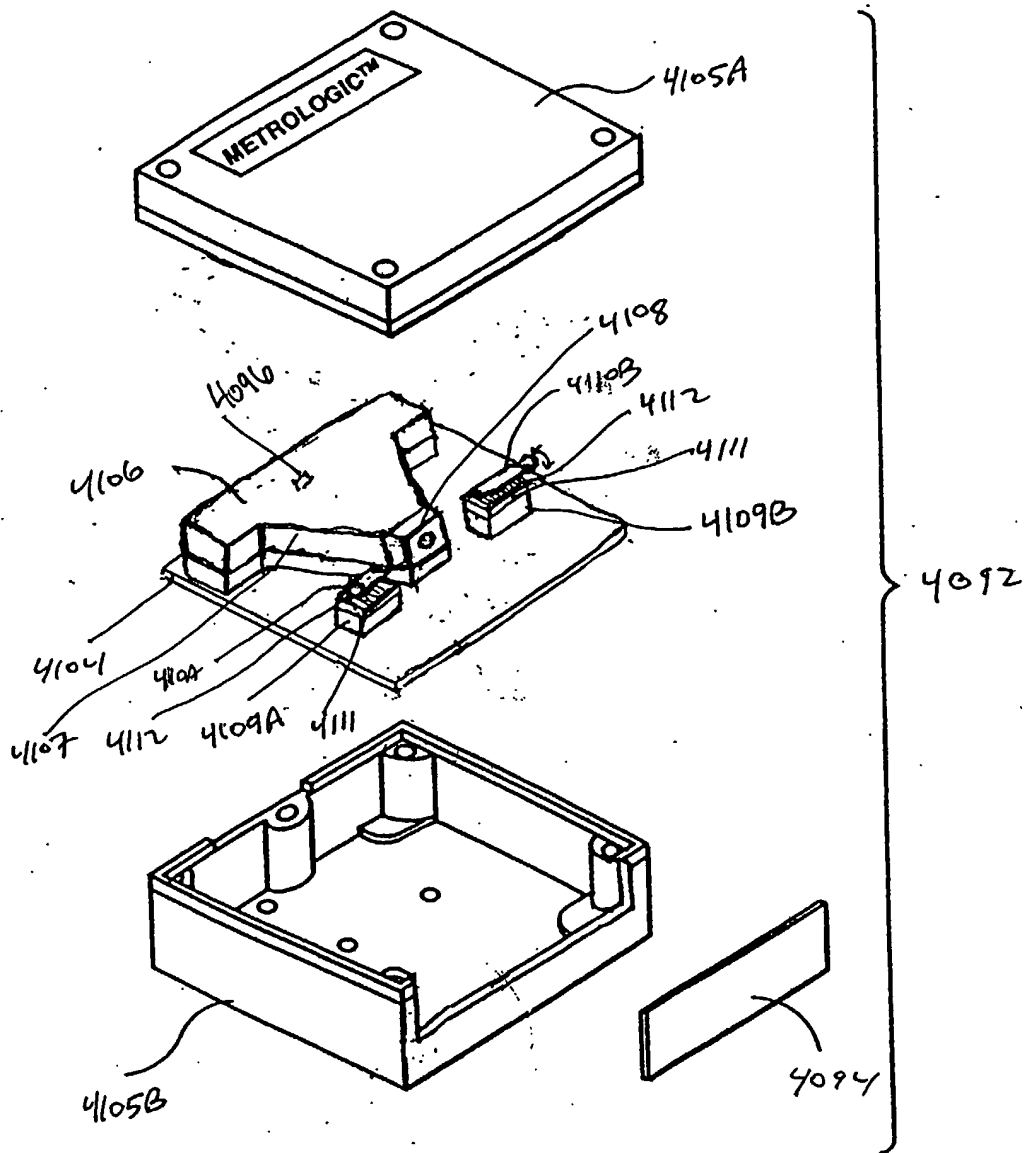


FIG. 55B

Brogg cell
Fig. 116A-6B

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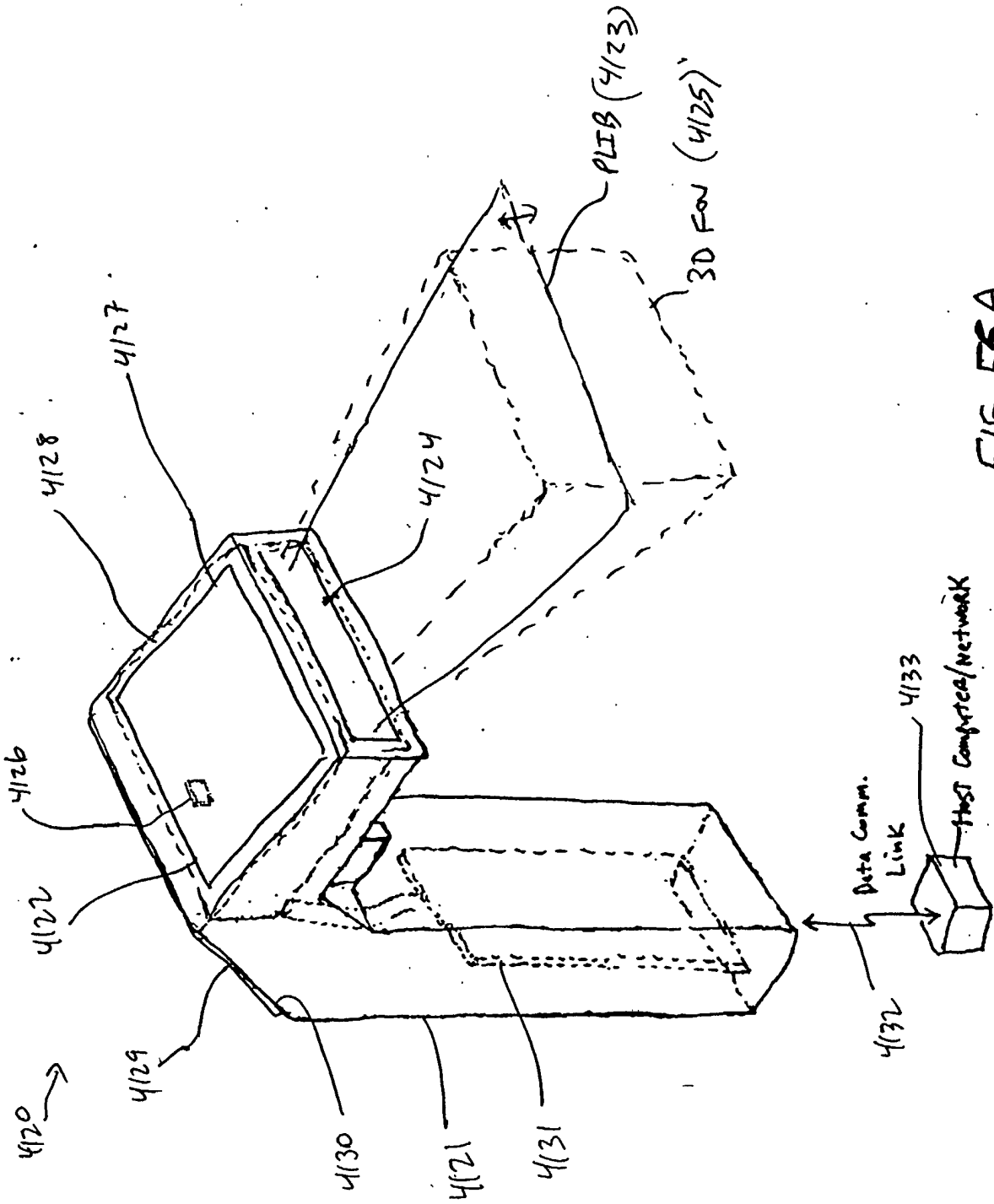


FIG. 56A

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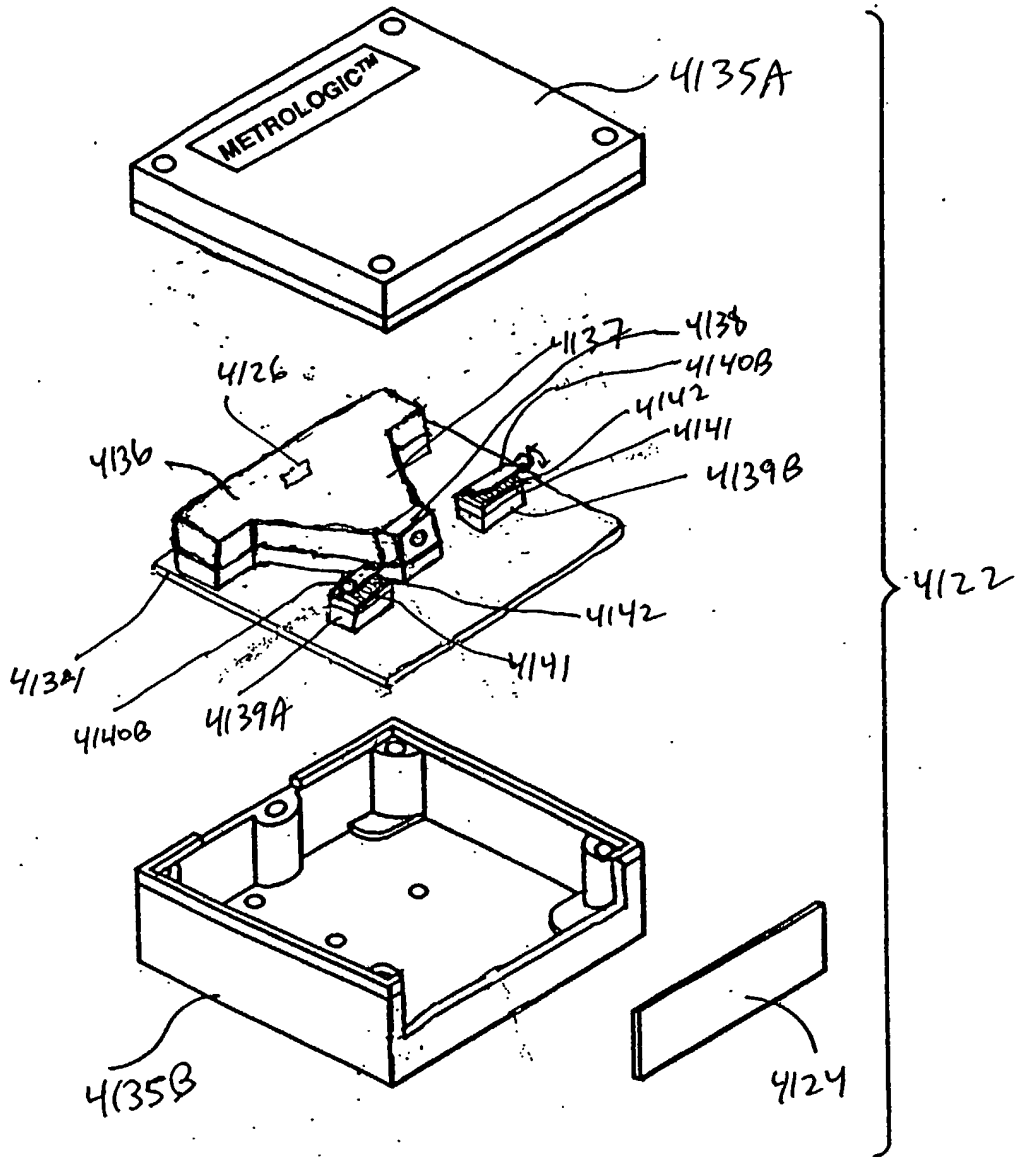
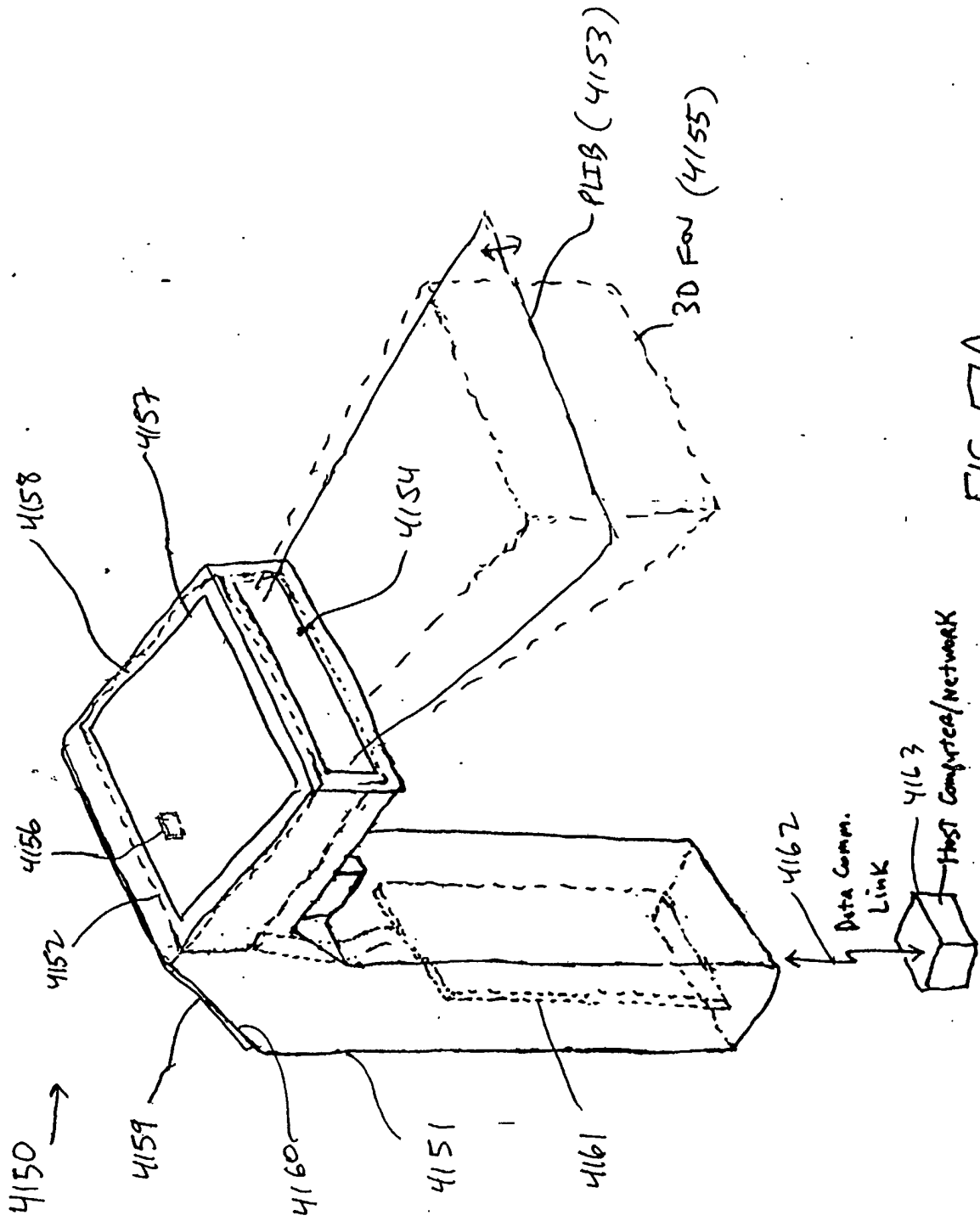


FIG. 56B

DM
Fig. 1F7A-7C

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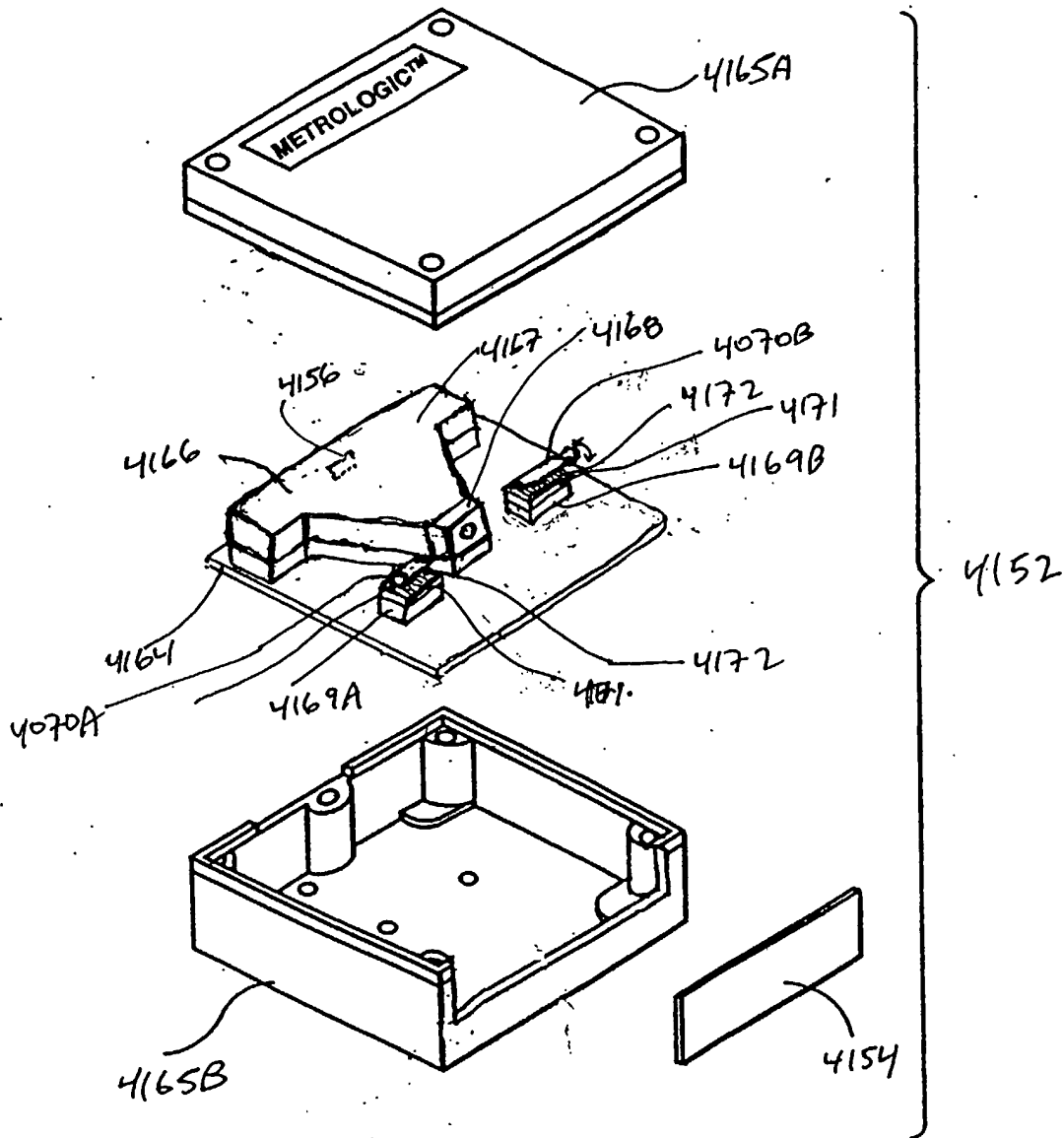


FIG. 57B

plus only LCR
pin panel

Fys 178F-86

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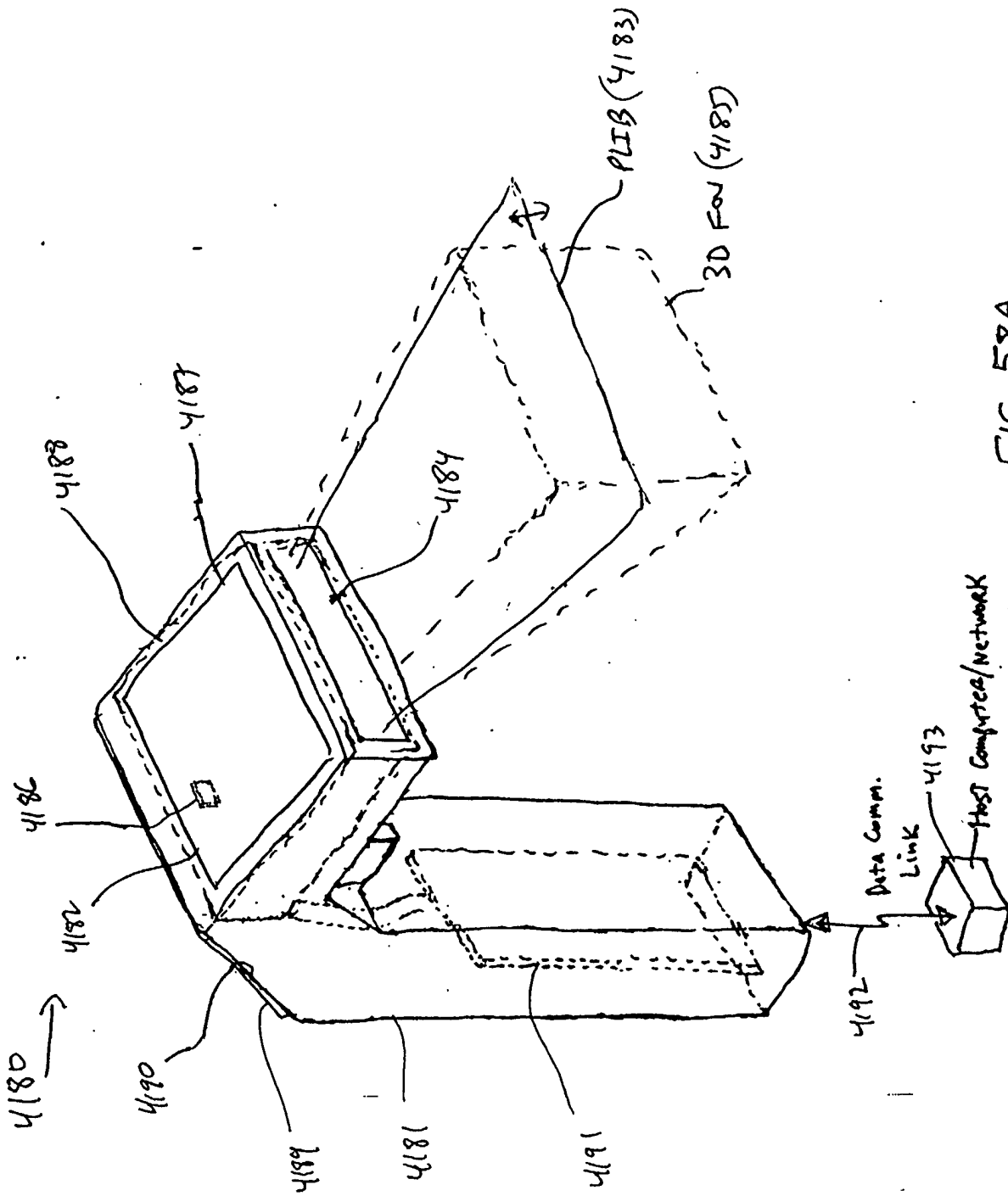


FIG. 58A

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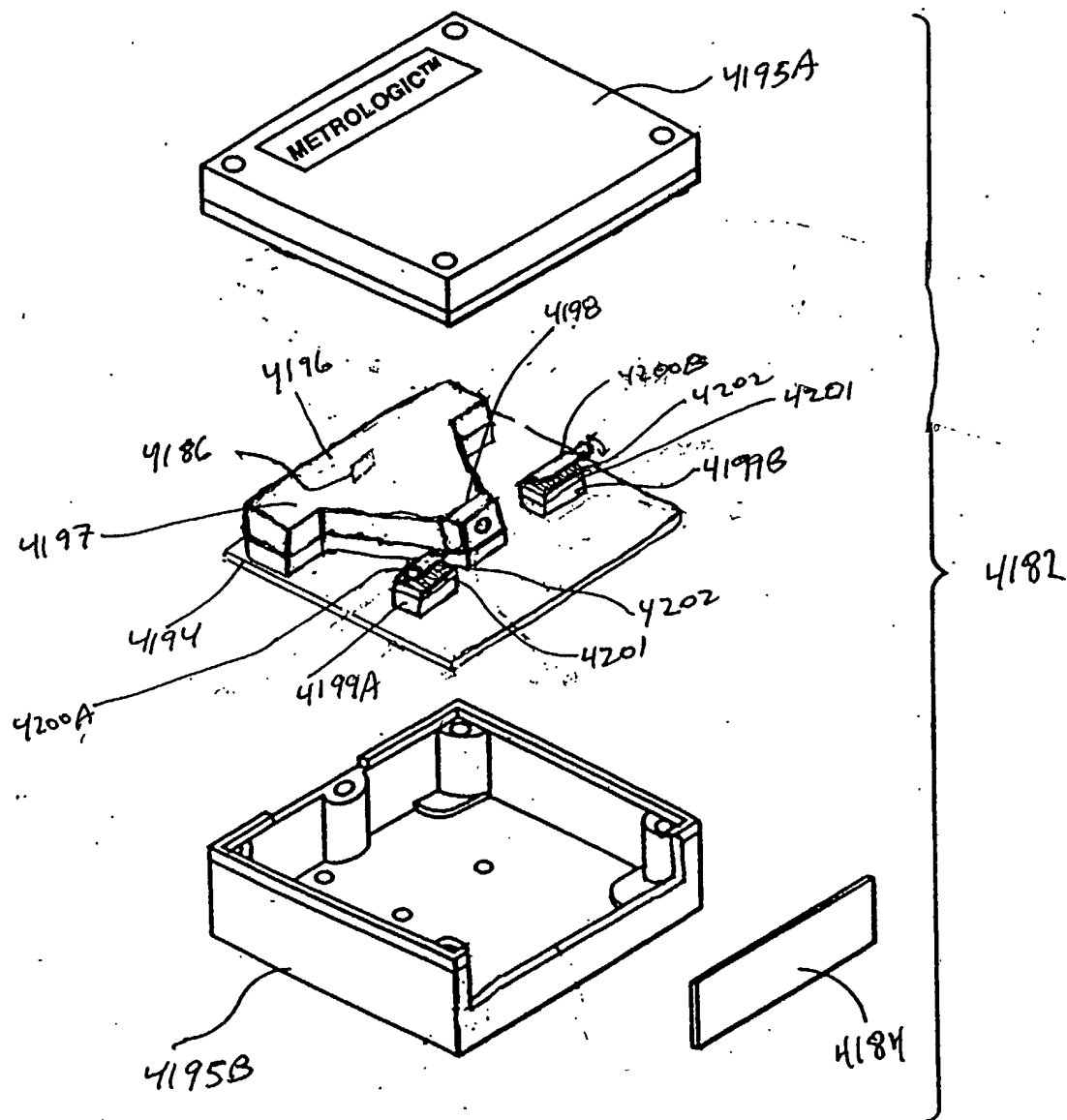


FIG. 58B

HS optical shutter
Fig. 1F 14A-14B

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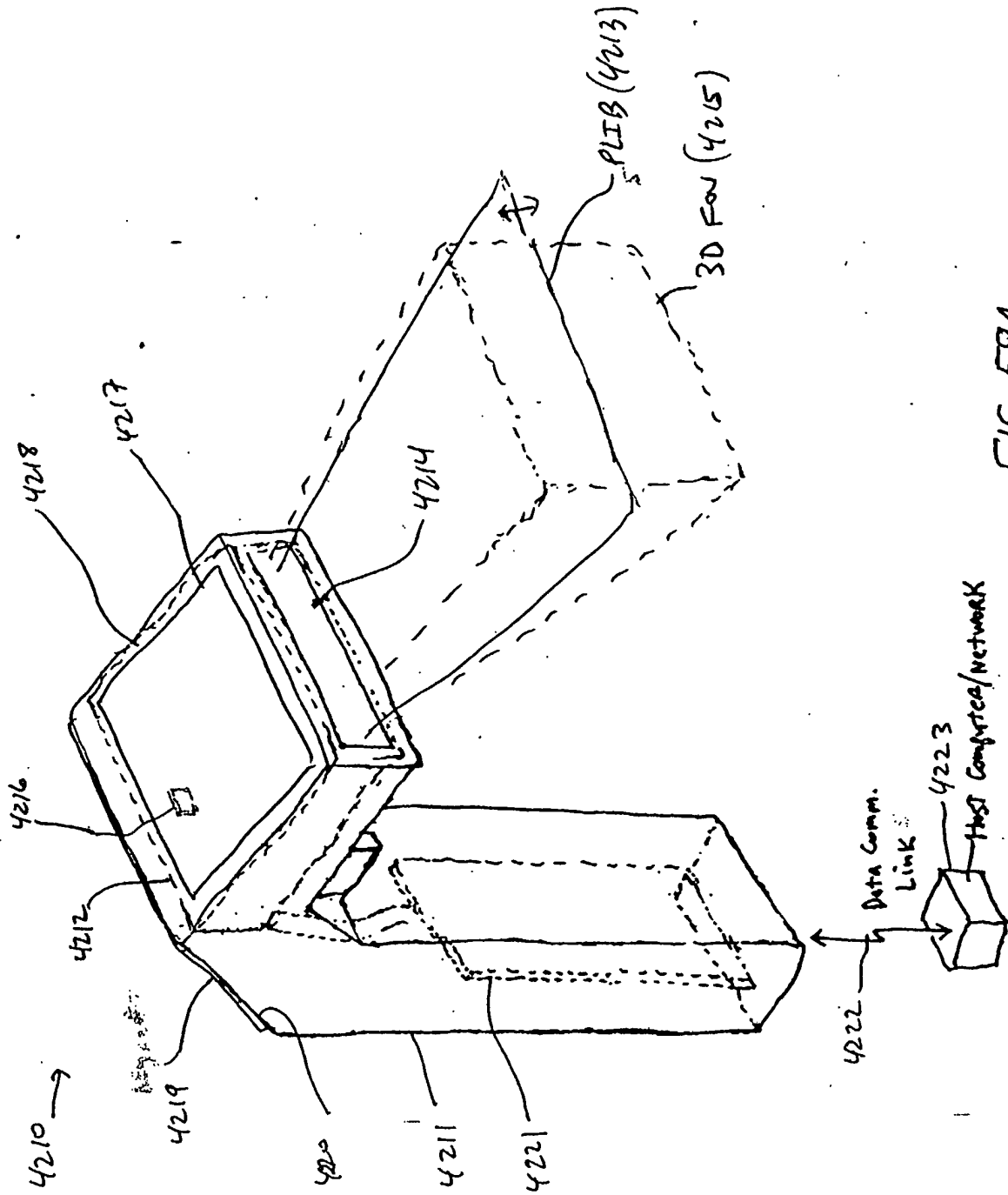


FIG. 59A

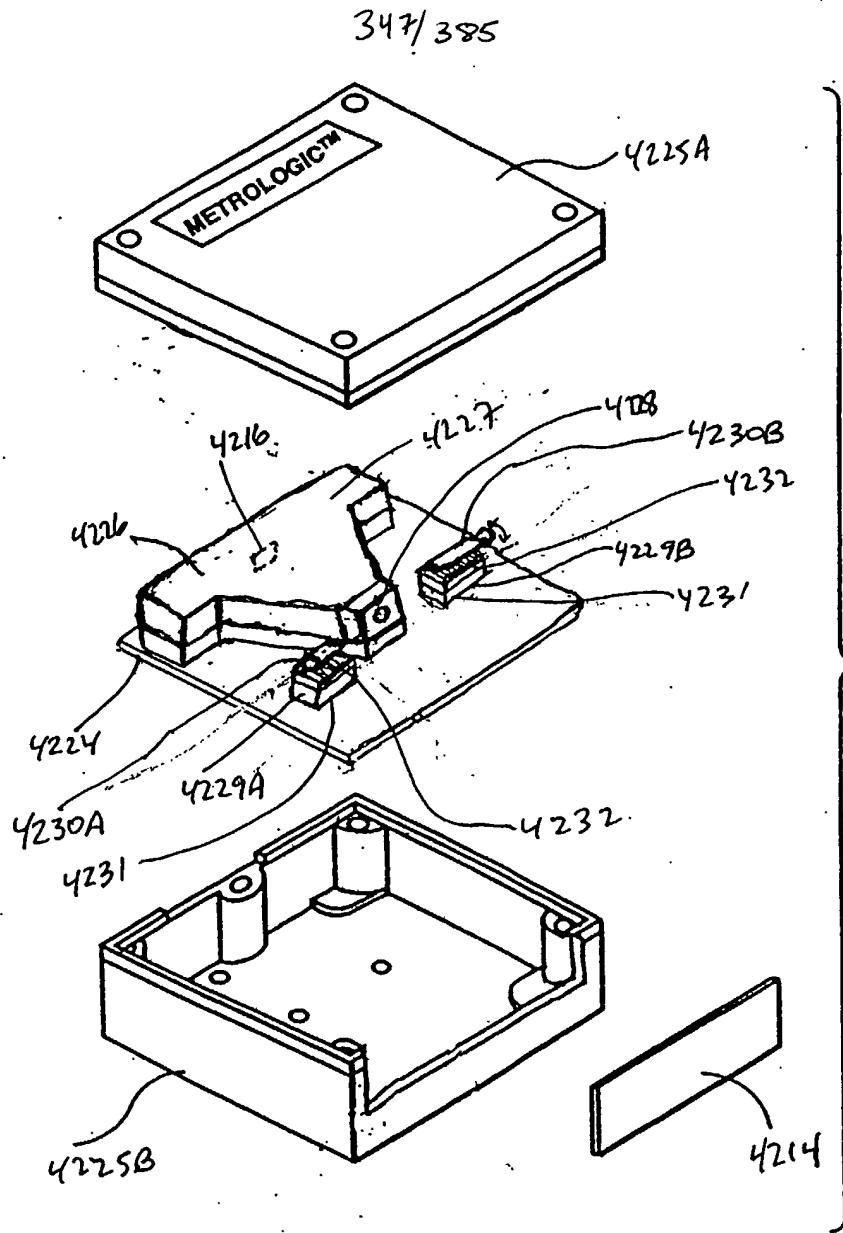


FIG. 59B

MLD
Fig. 1E15A-15B

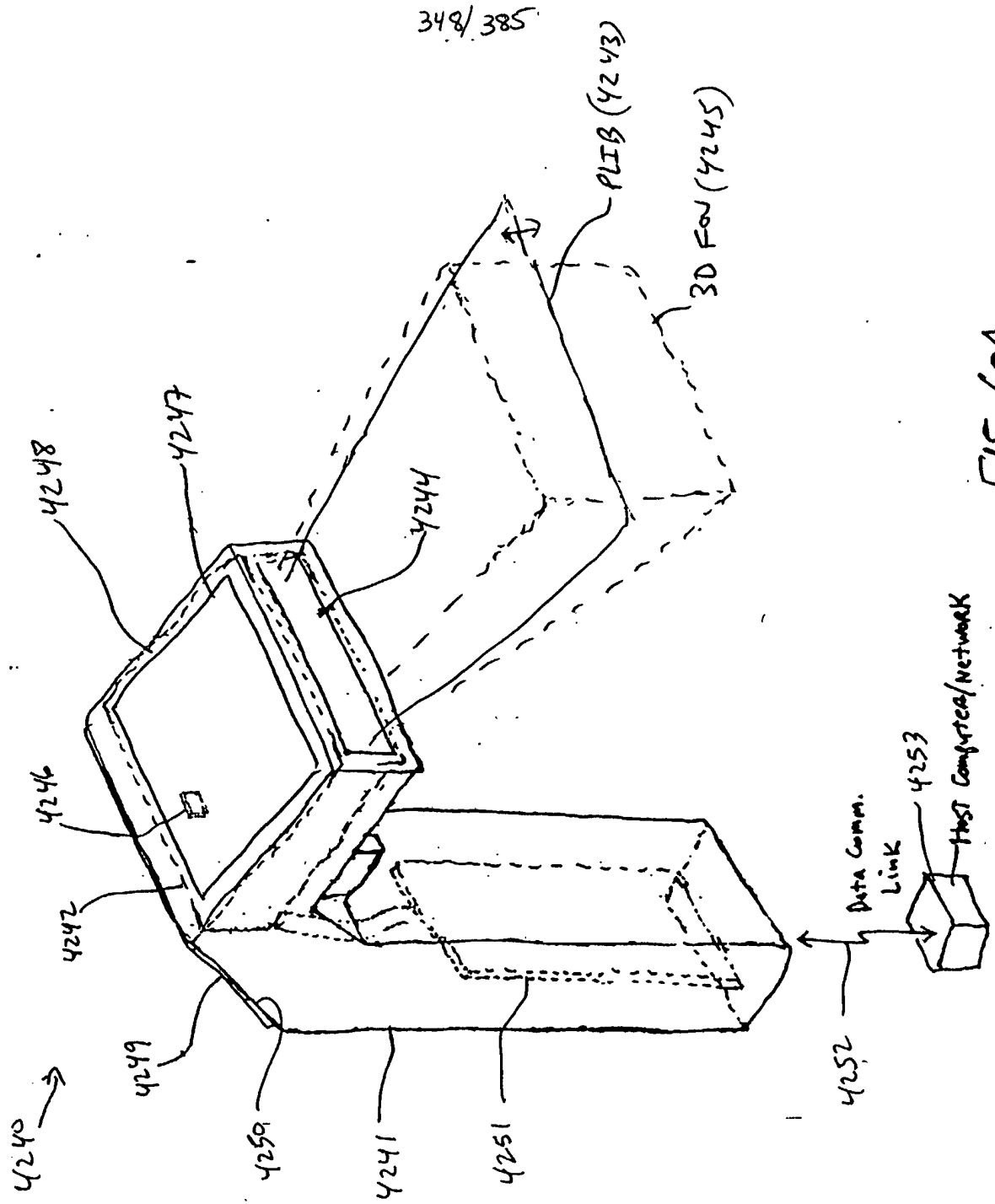


FIG. 60A

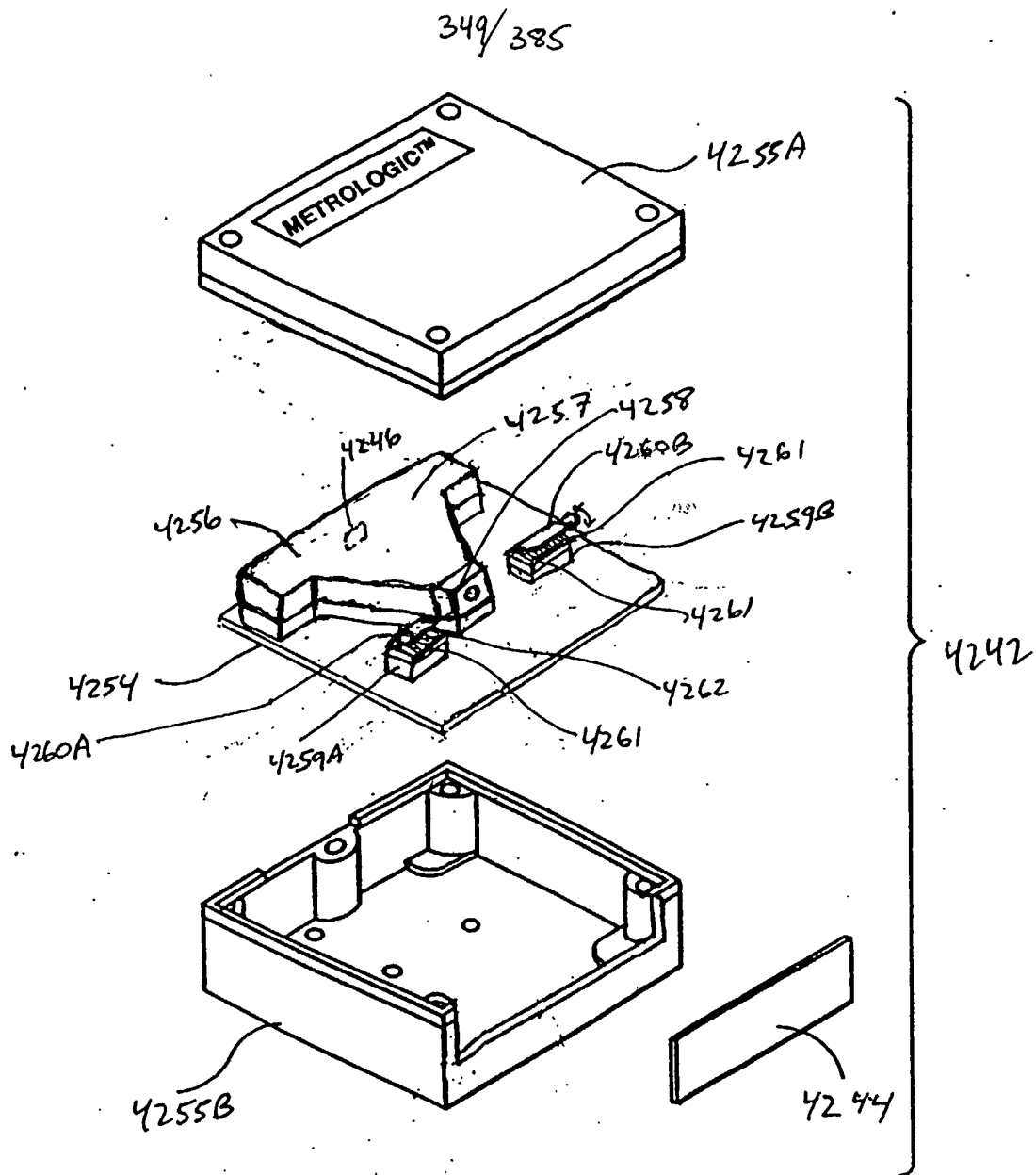
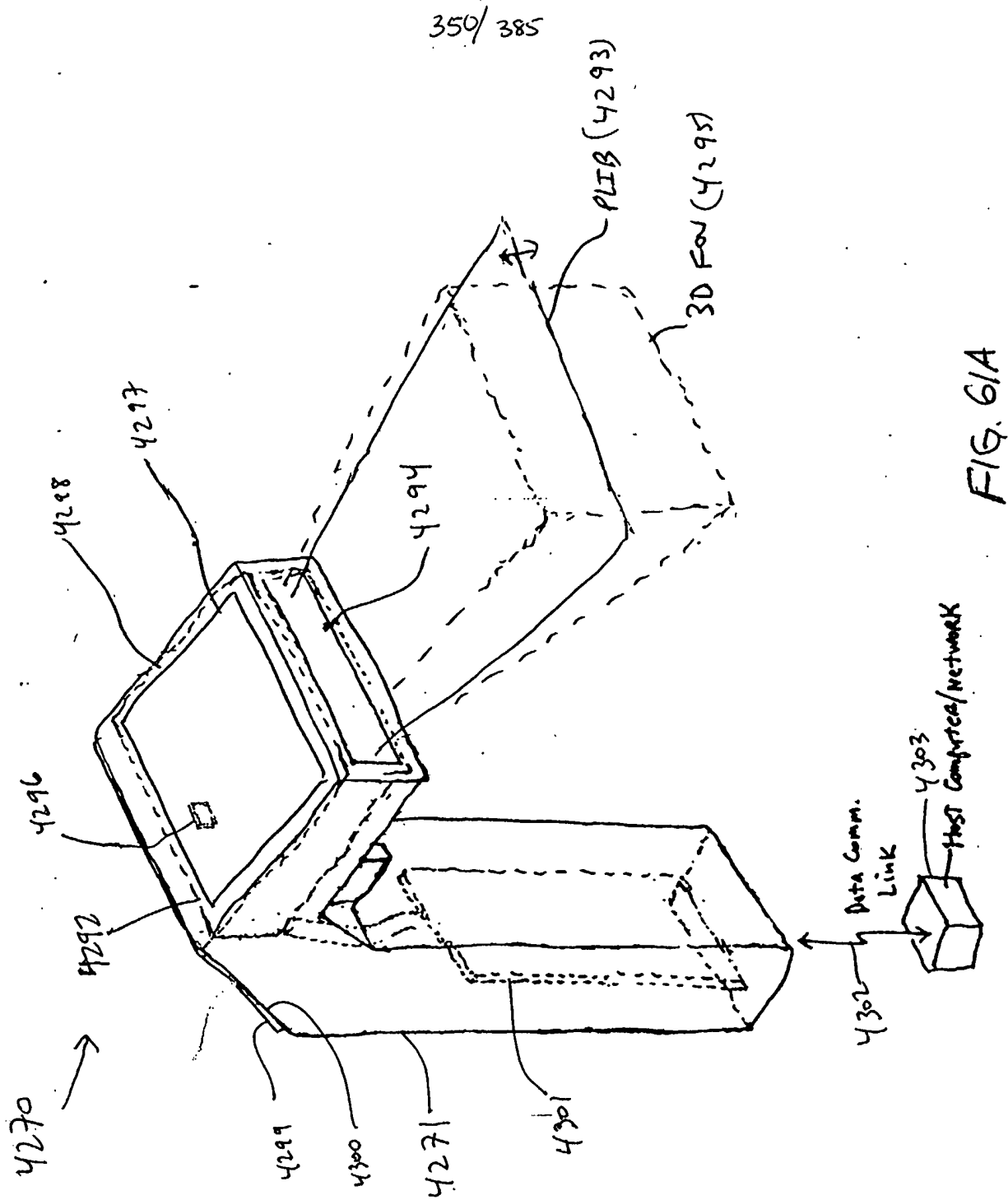


FIG. 60B

Bthalon (Temp. phase mod.)
Fig. 117A-17B



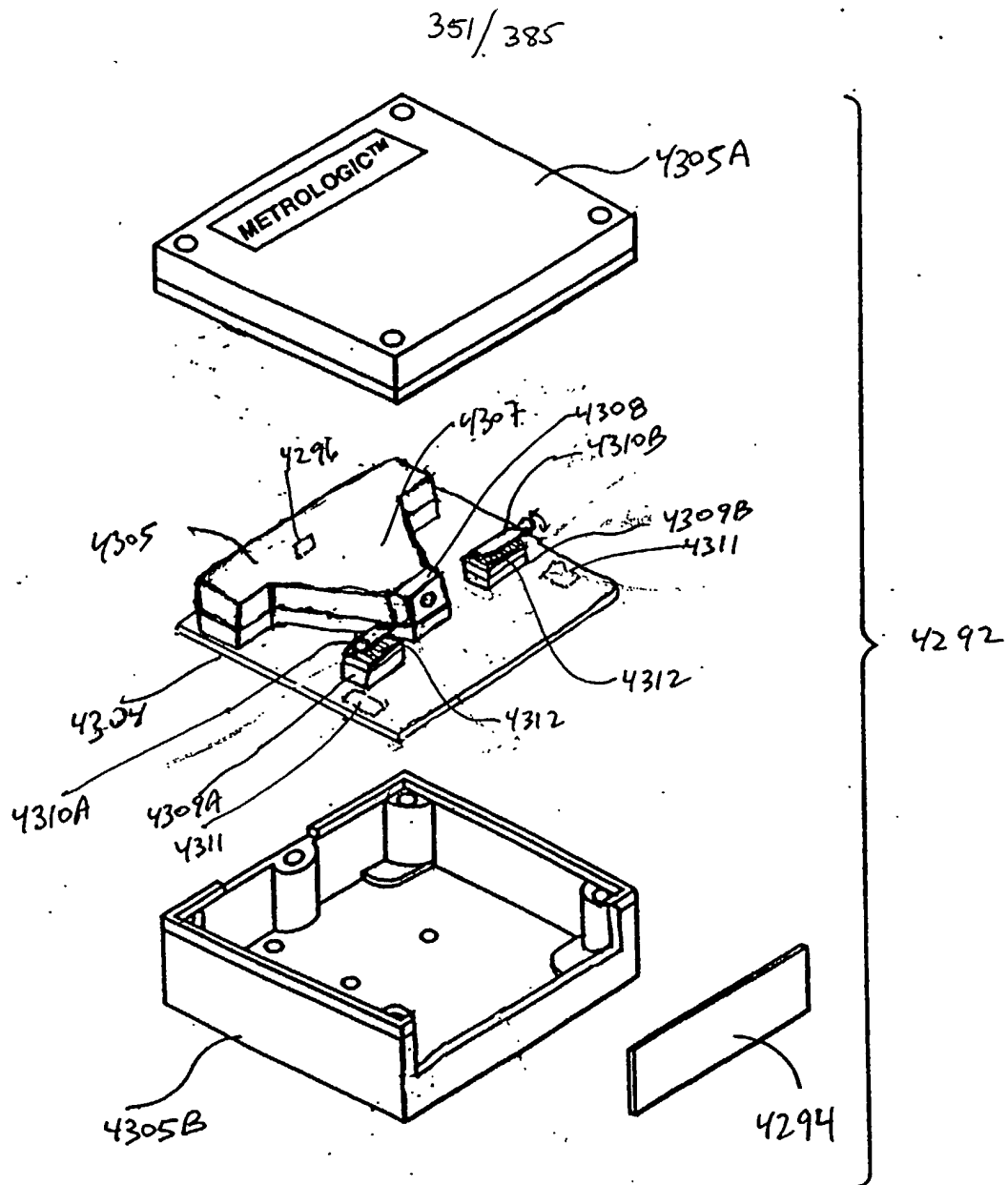


FIG. 61B

mod. hugging

Fig. 1A-19B

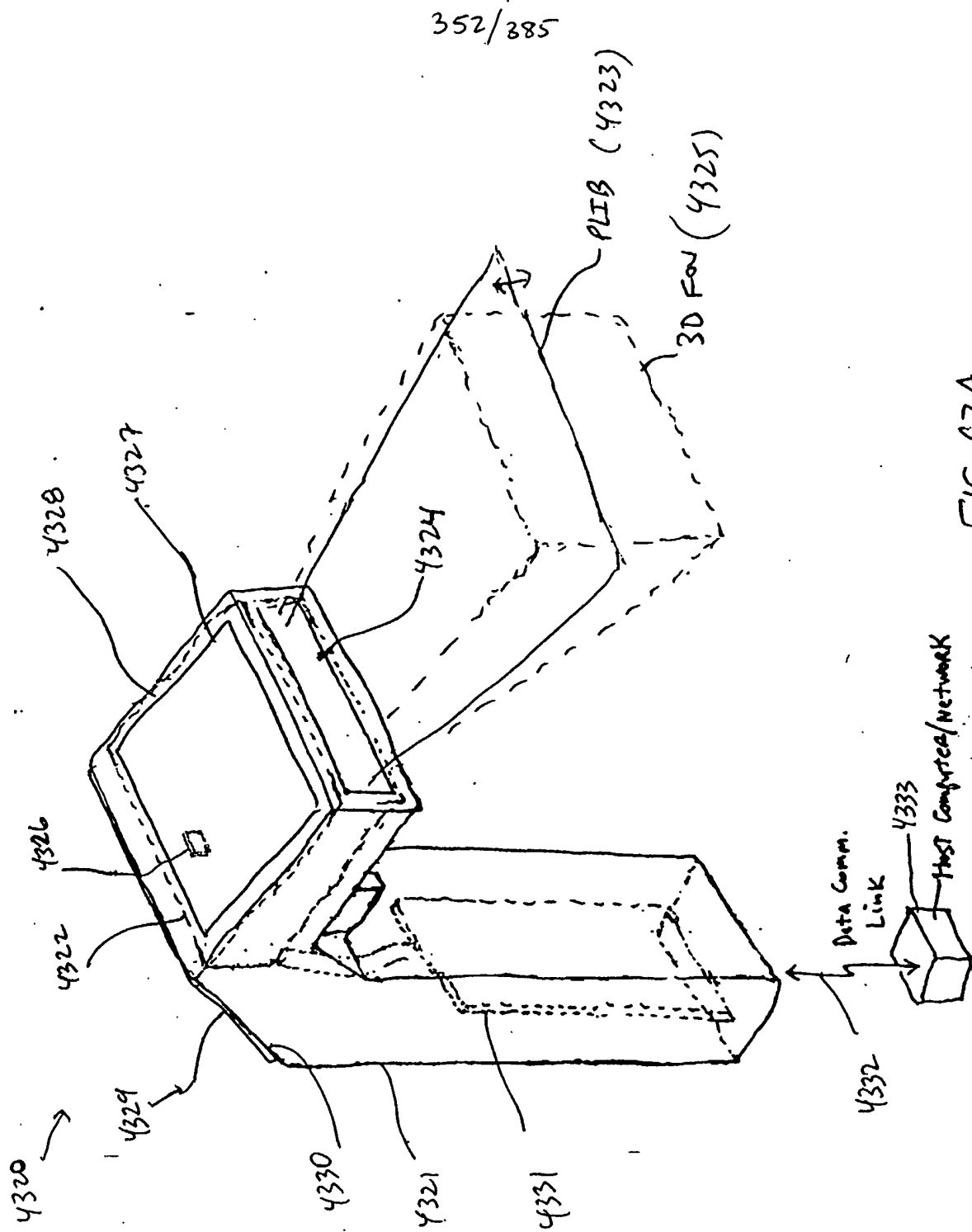


FIG. 62A

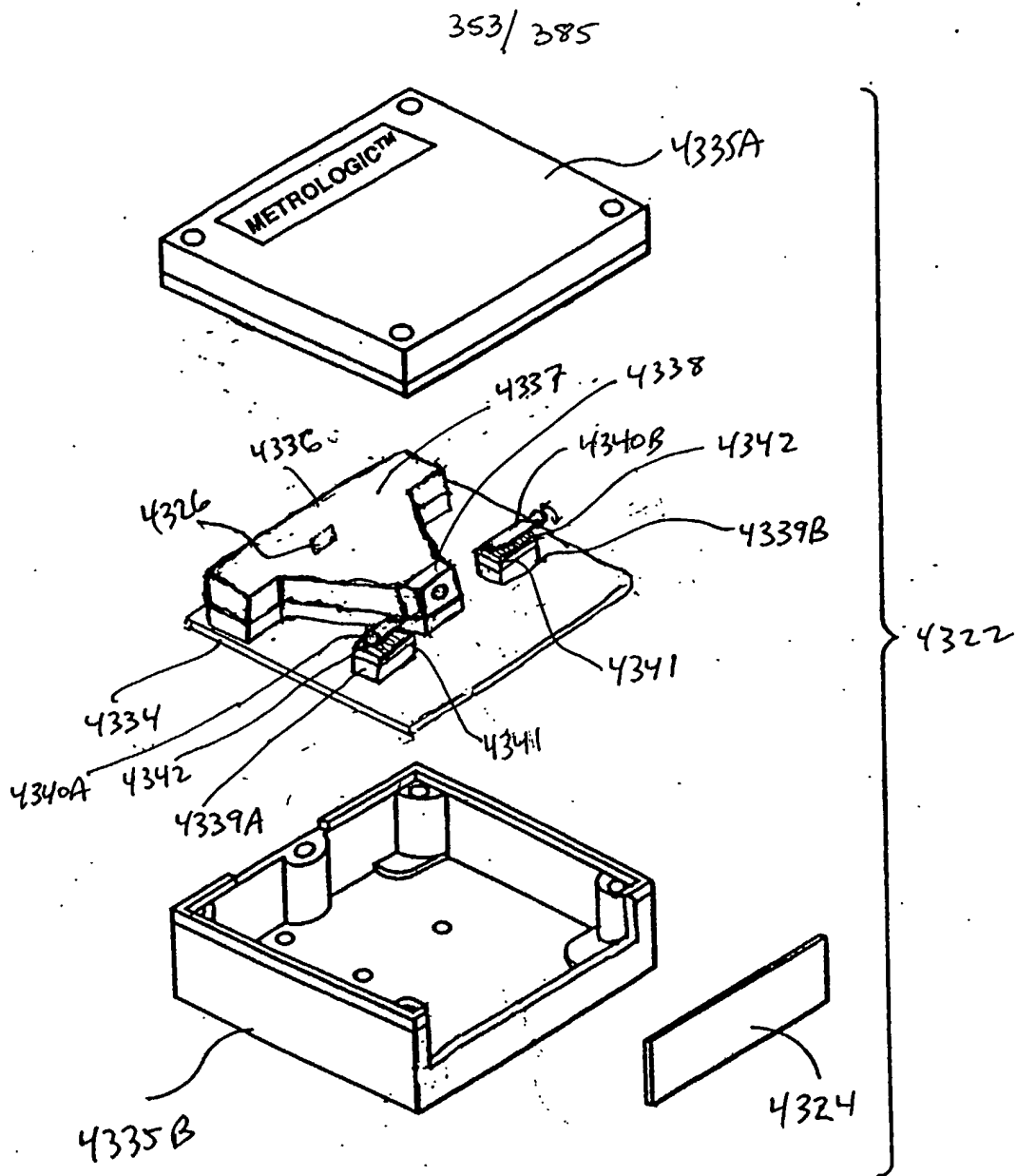


FIG. 62B

measuring
spot intensity
mod. panel

Fig. 1F21A-21D

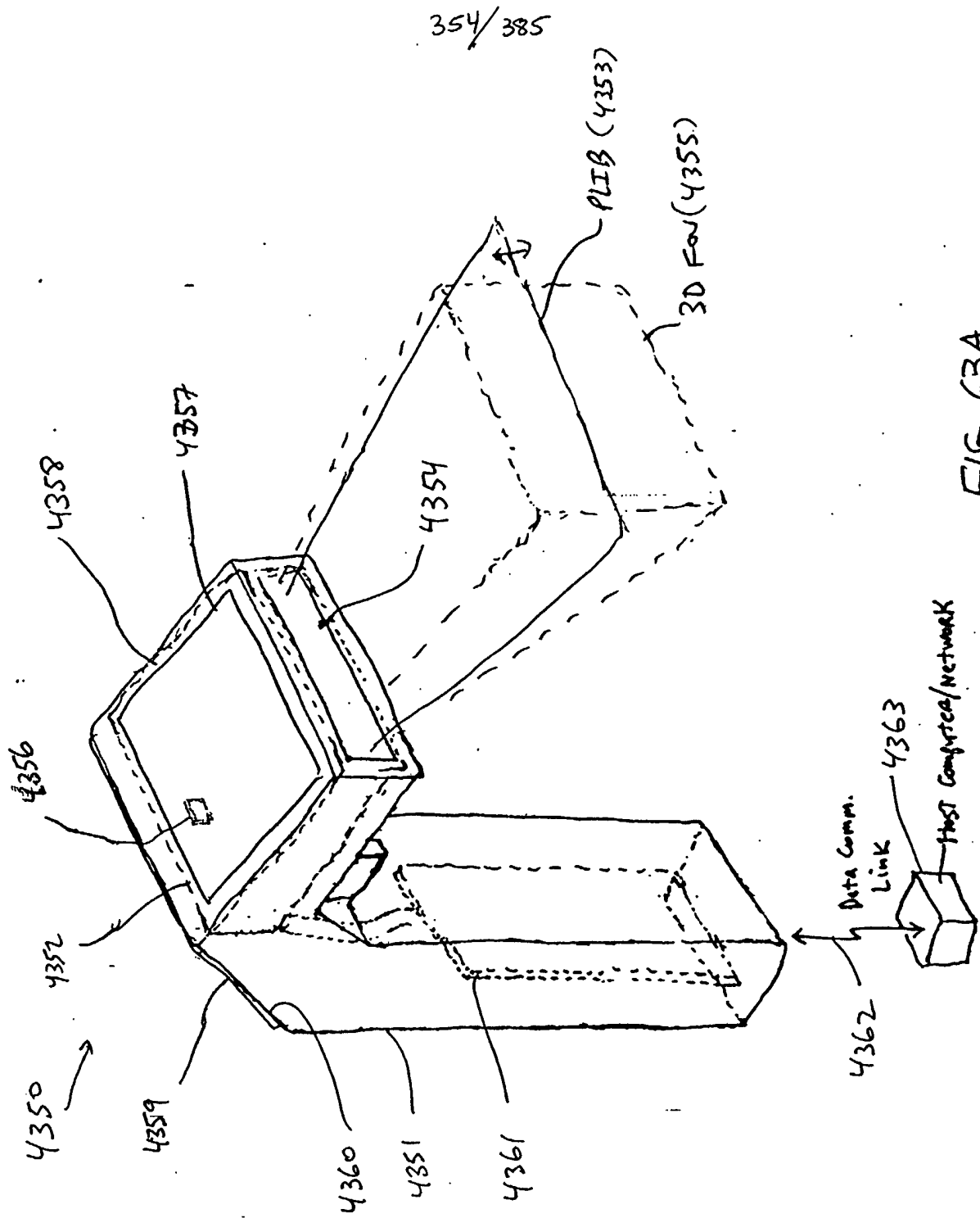


FIG. 63A

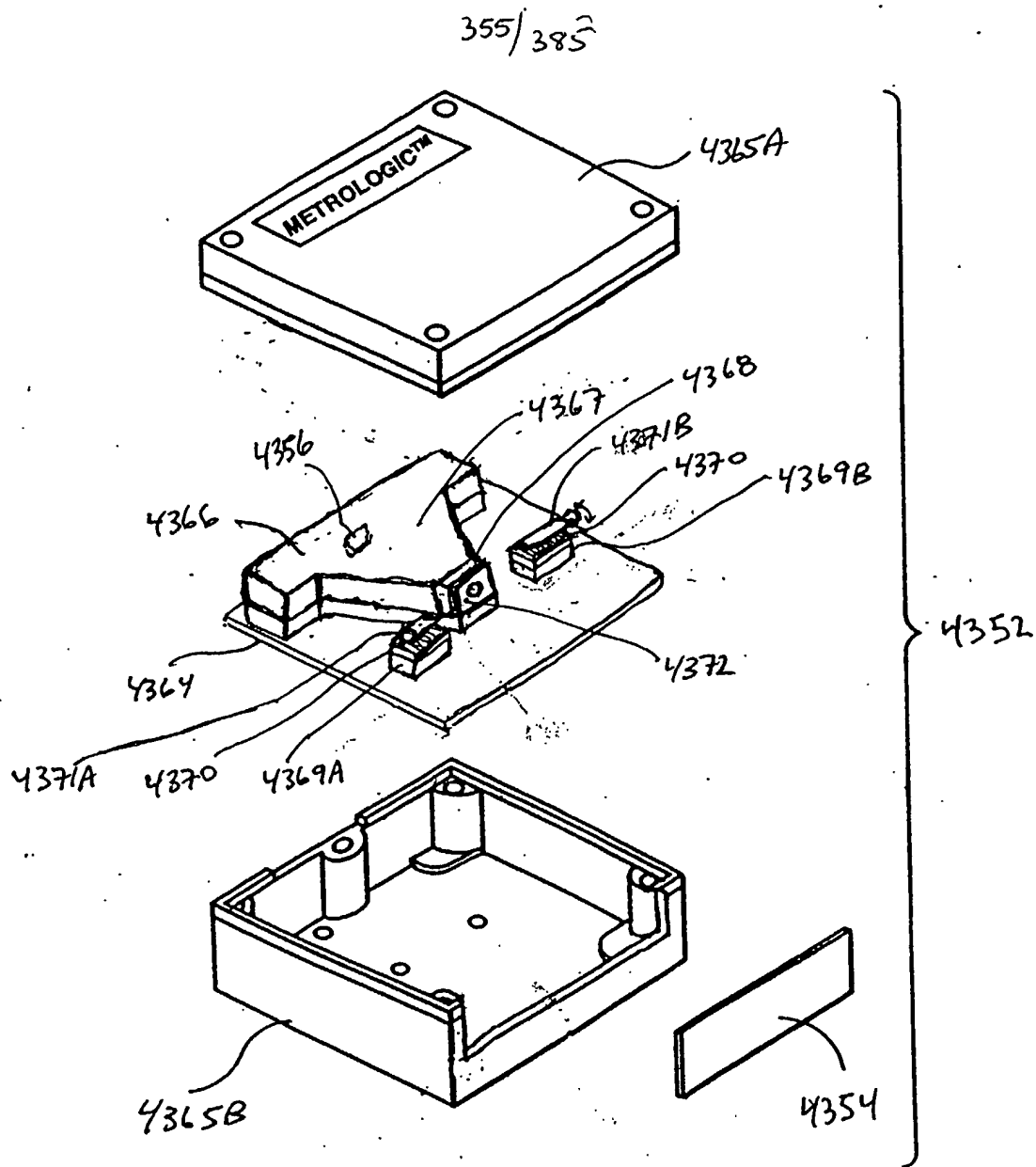


FIG. 63B

Ed or.
Mechanical part of the I/O

Fig 1st 23A-23B

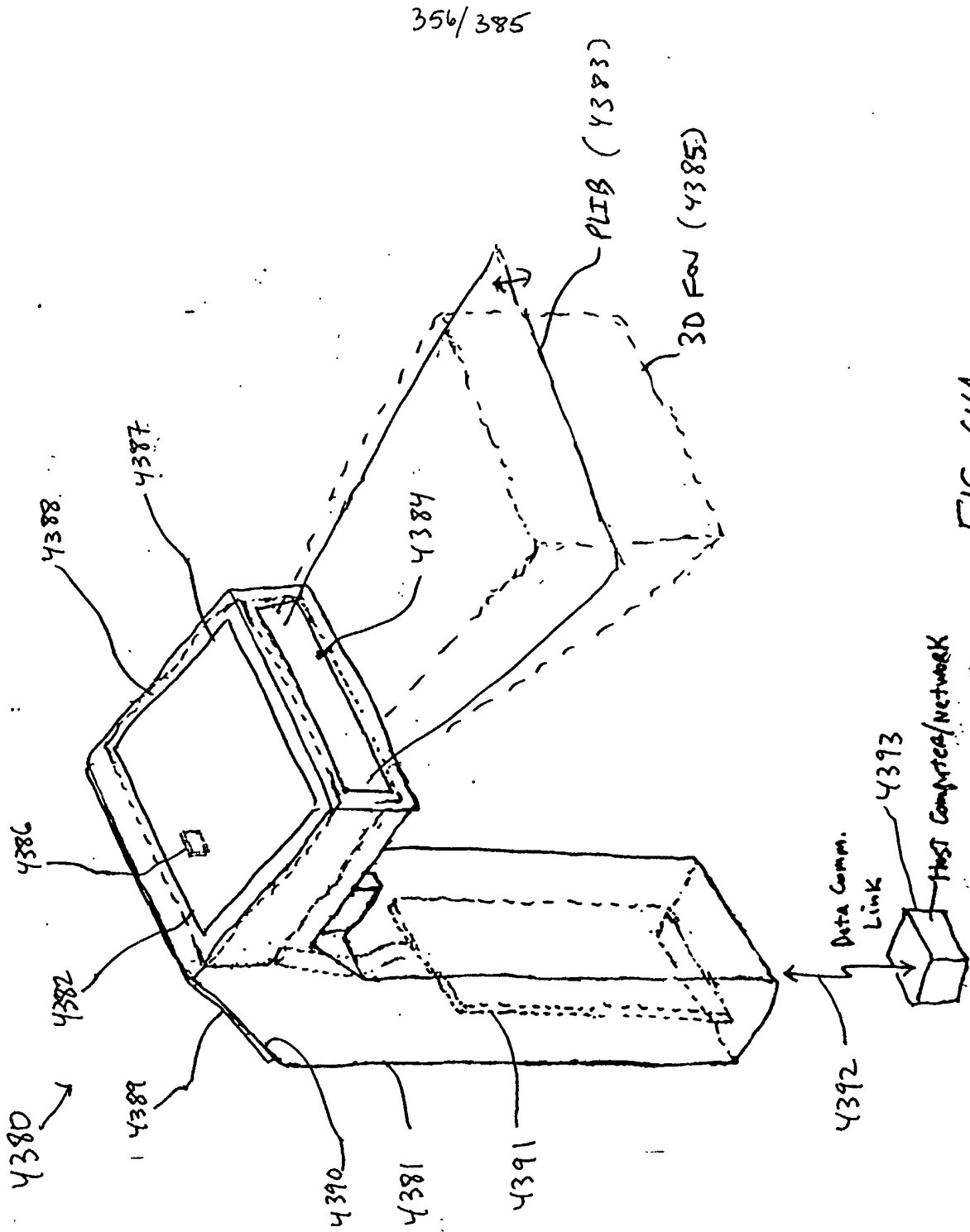


FIG. 64A

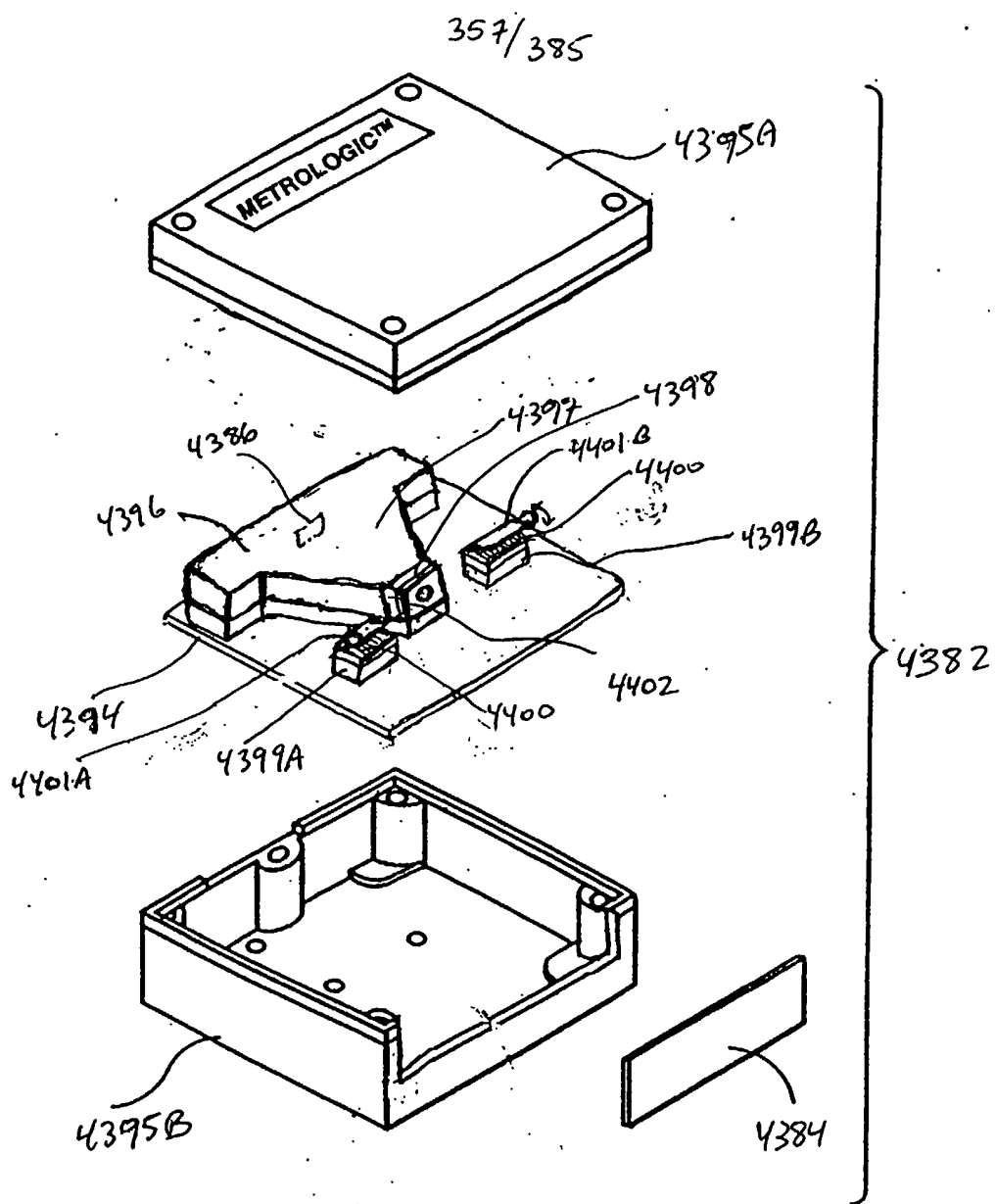


FIG. 64B

* E-optical
Shutter Buffer
IP Lens
Fig. 1124A

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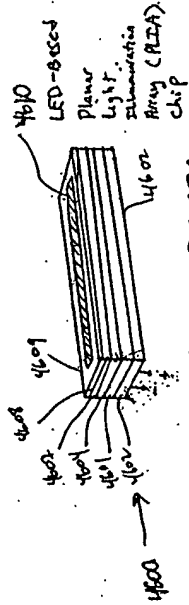


FIG. 67A

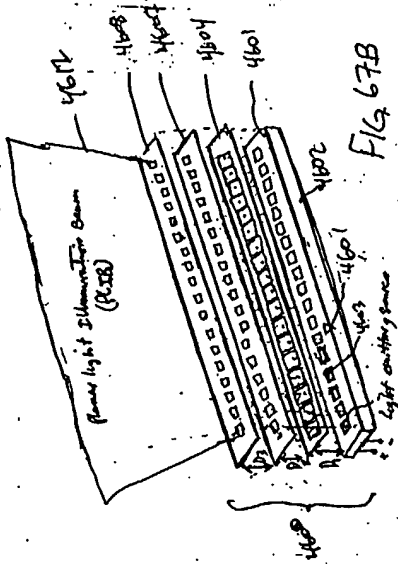


FIG. 67B

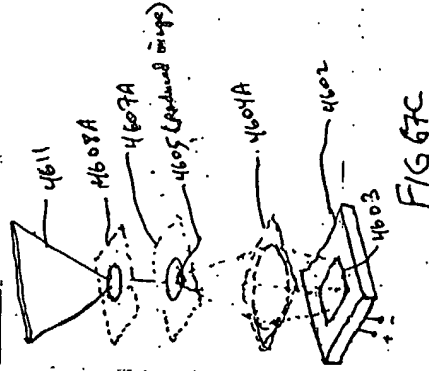


FIG. 67C

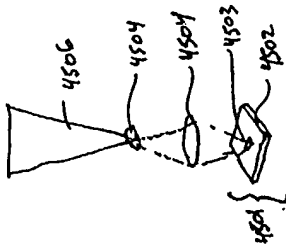


FIG. 65B

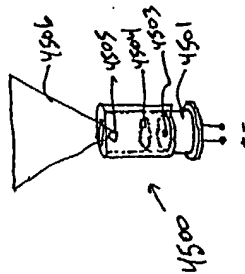


FIG. 65A

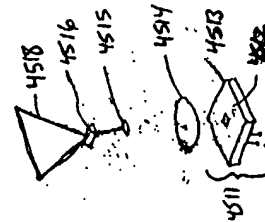


FIG. 66B

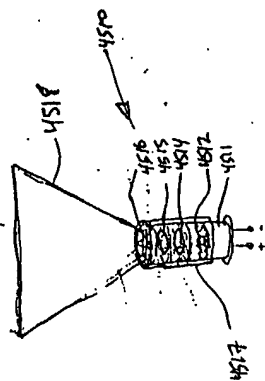


FIG. 66A

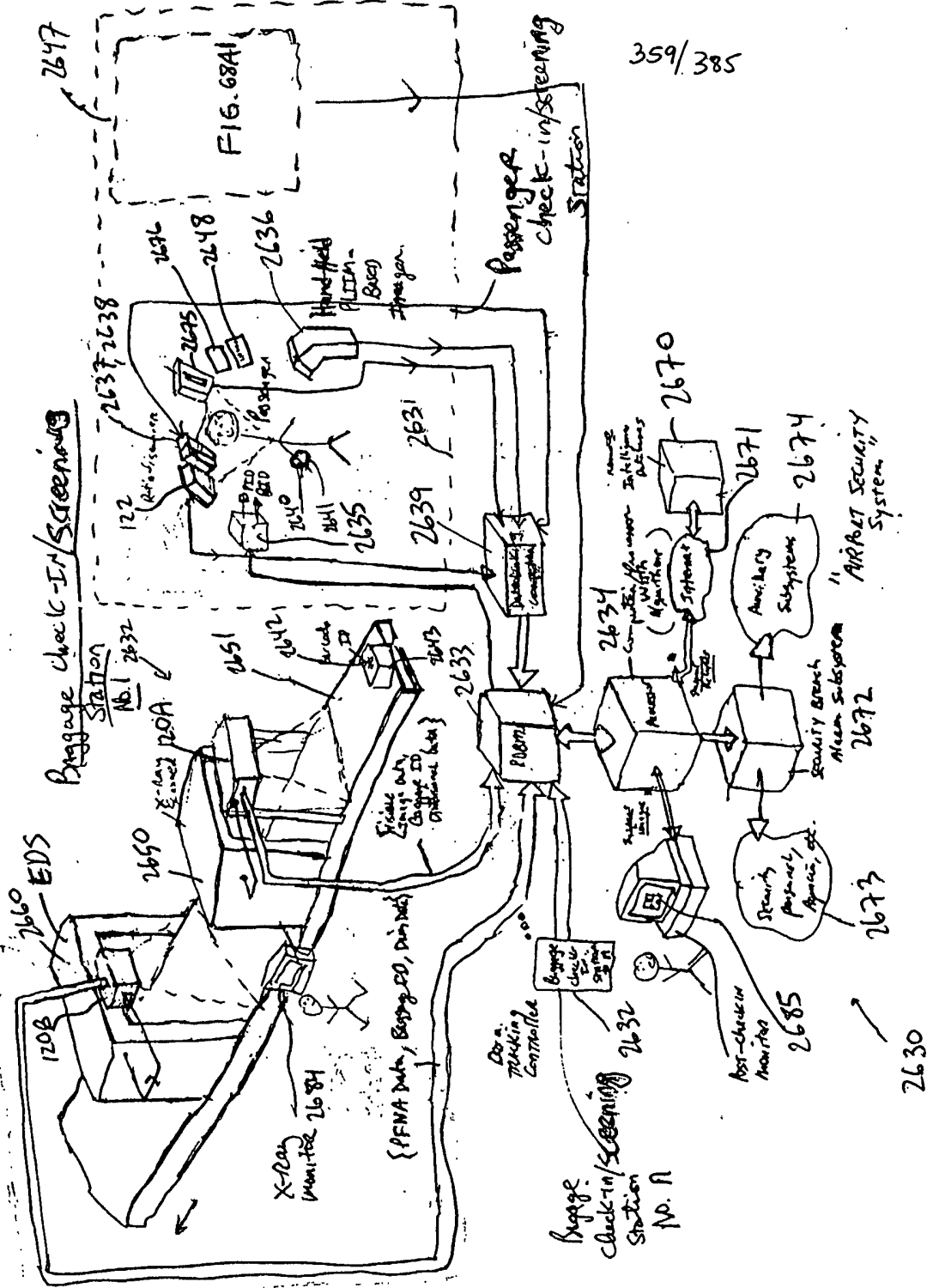


FIG. 68.

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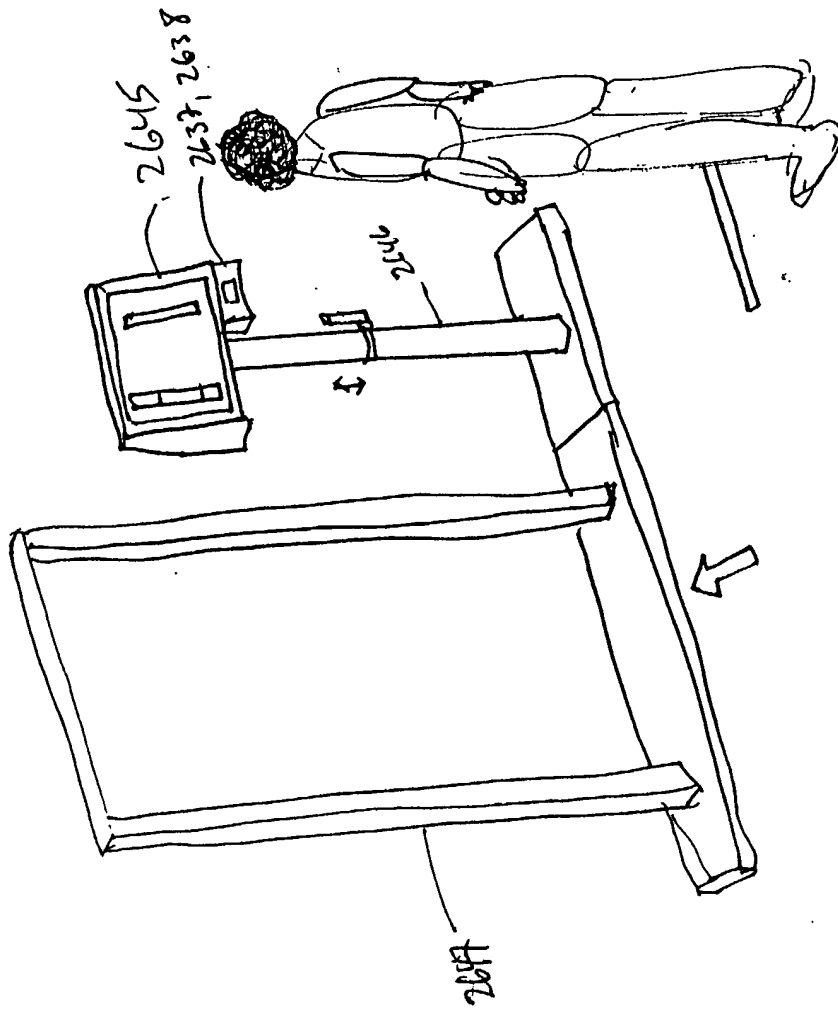


FIG. 68A

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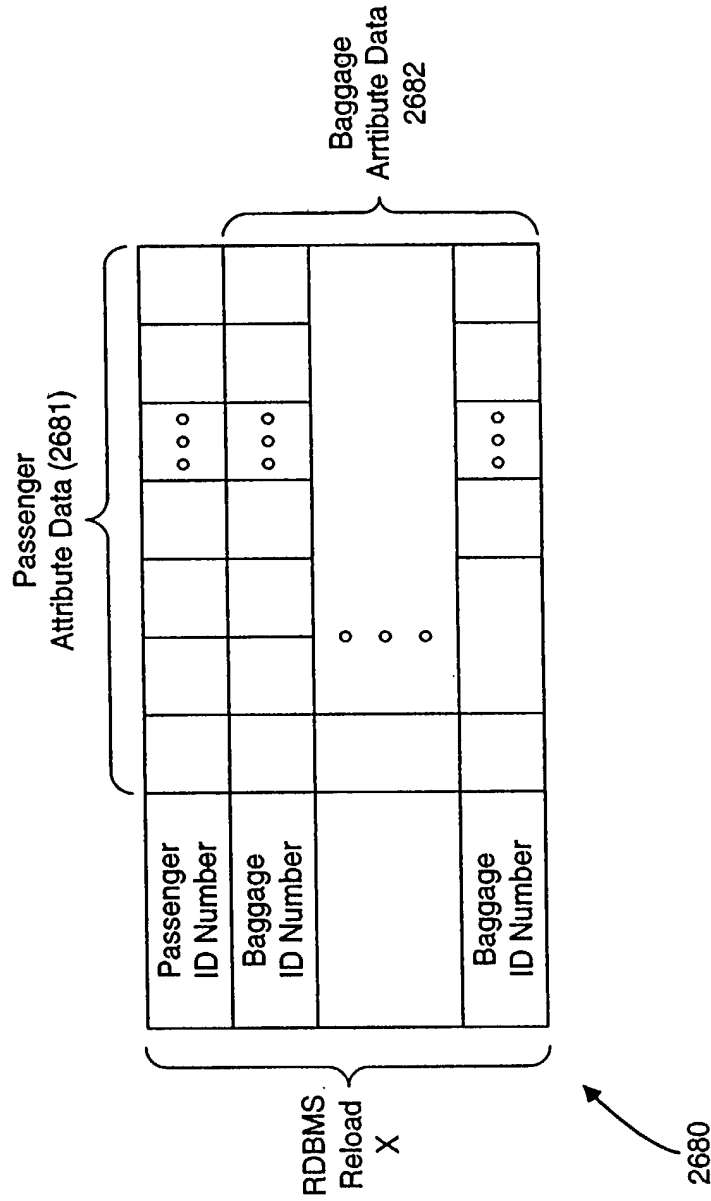


FIG. 68B

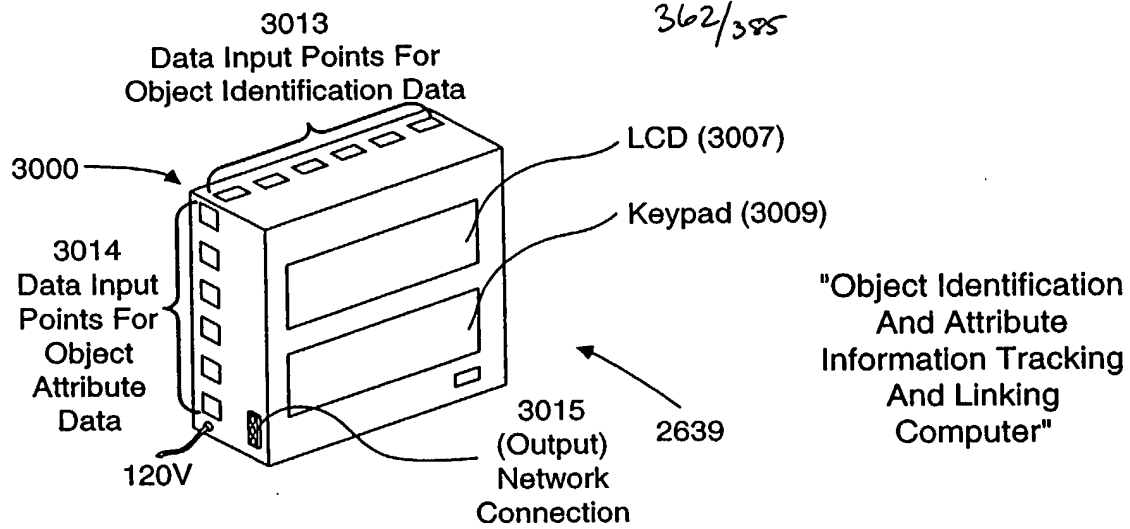


FIG. 68C1

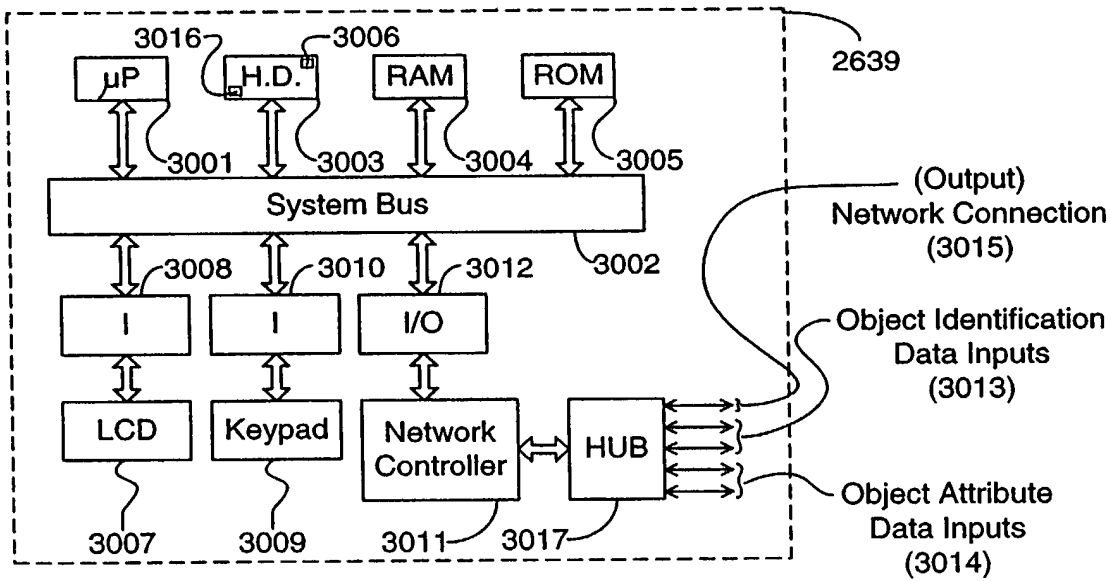


FIG. 68C2

Object Identification And Attribute Information Tracking And Linking Computer System.

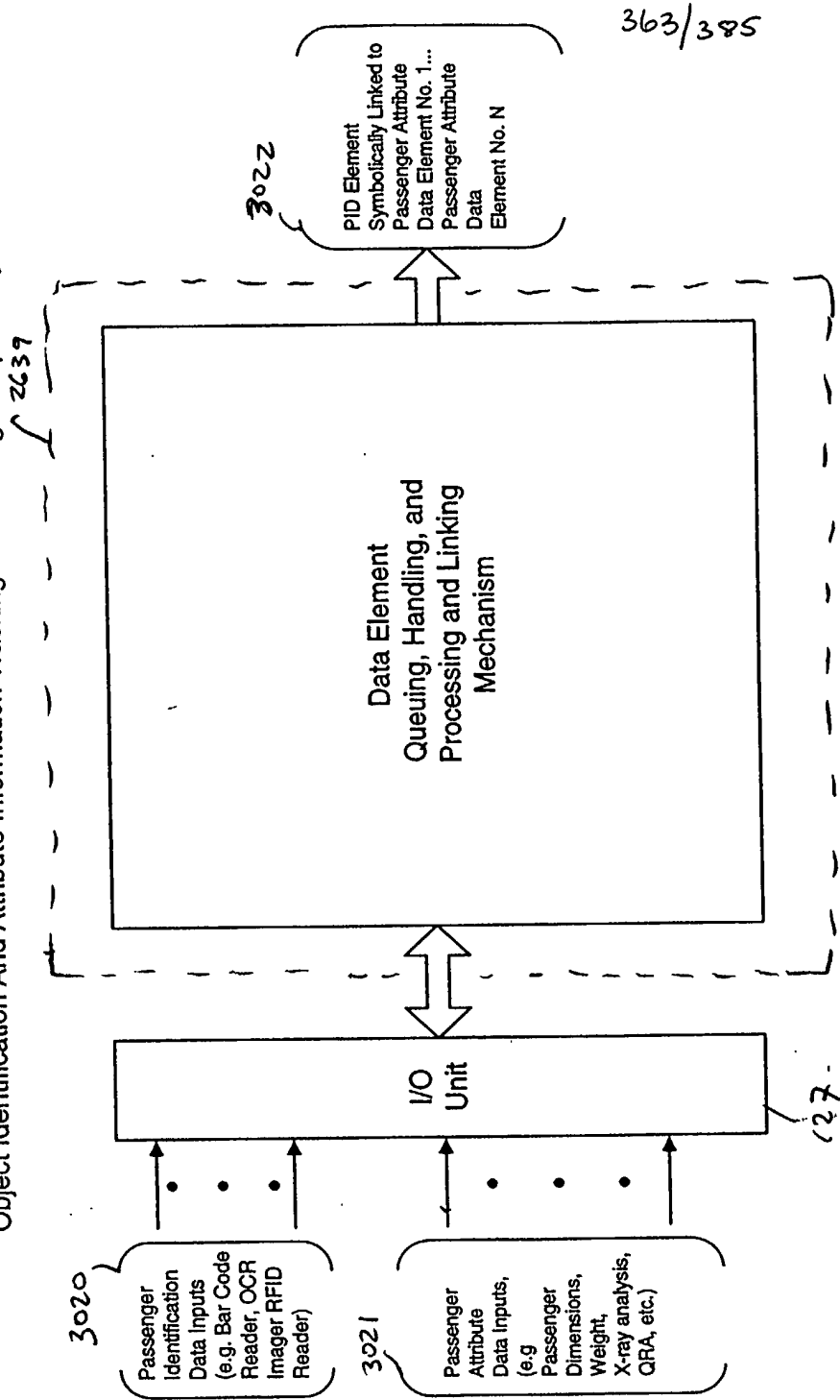


FIG. 68C3

Data Element Queuing, Handling, and Processing Subsystem Employed In The Object Identification And Attribute Acquisition System Of The Present Invention. (131)

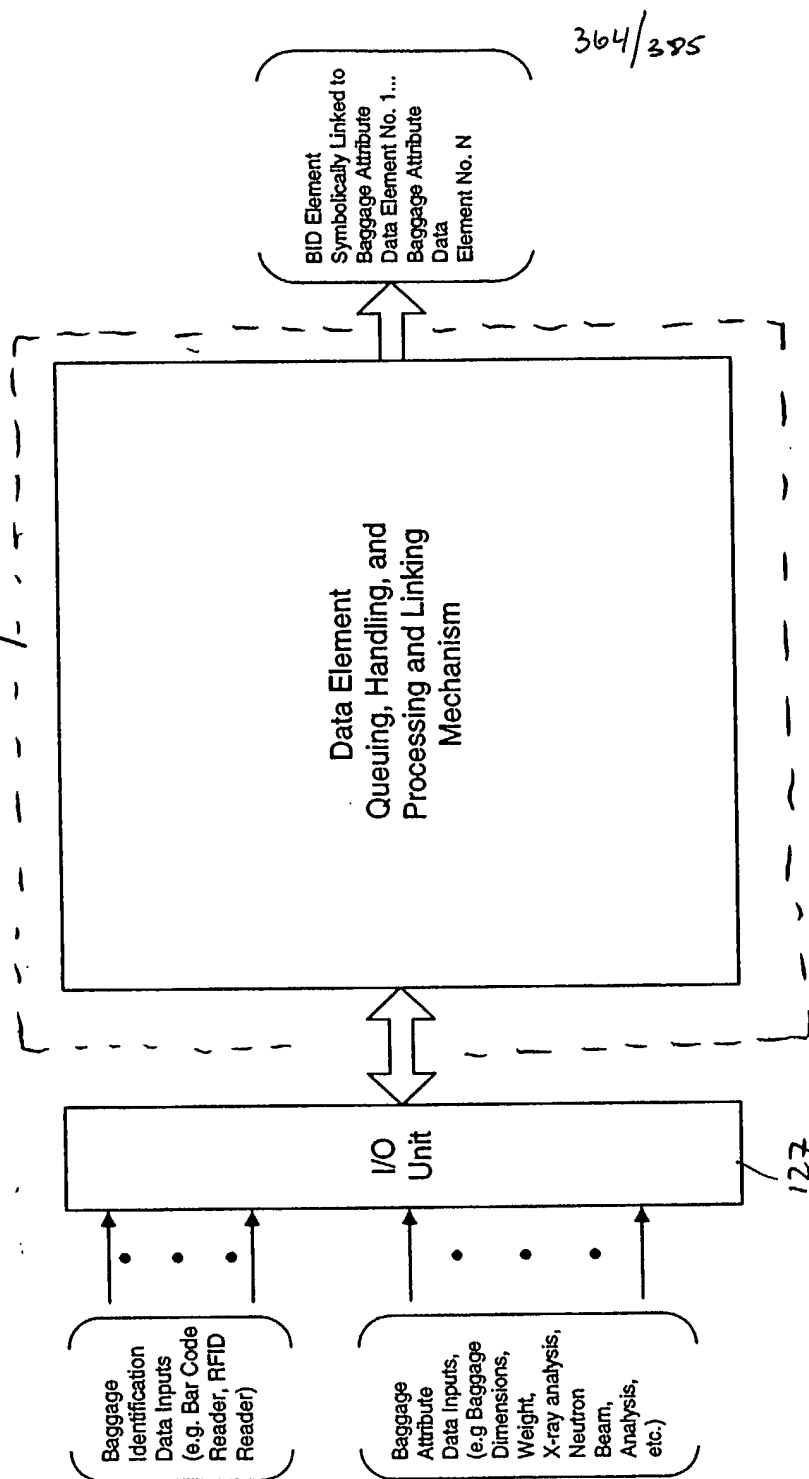


FIG. 68C4

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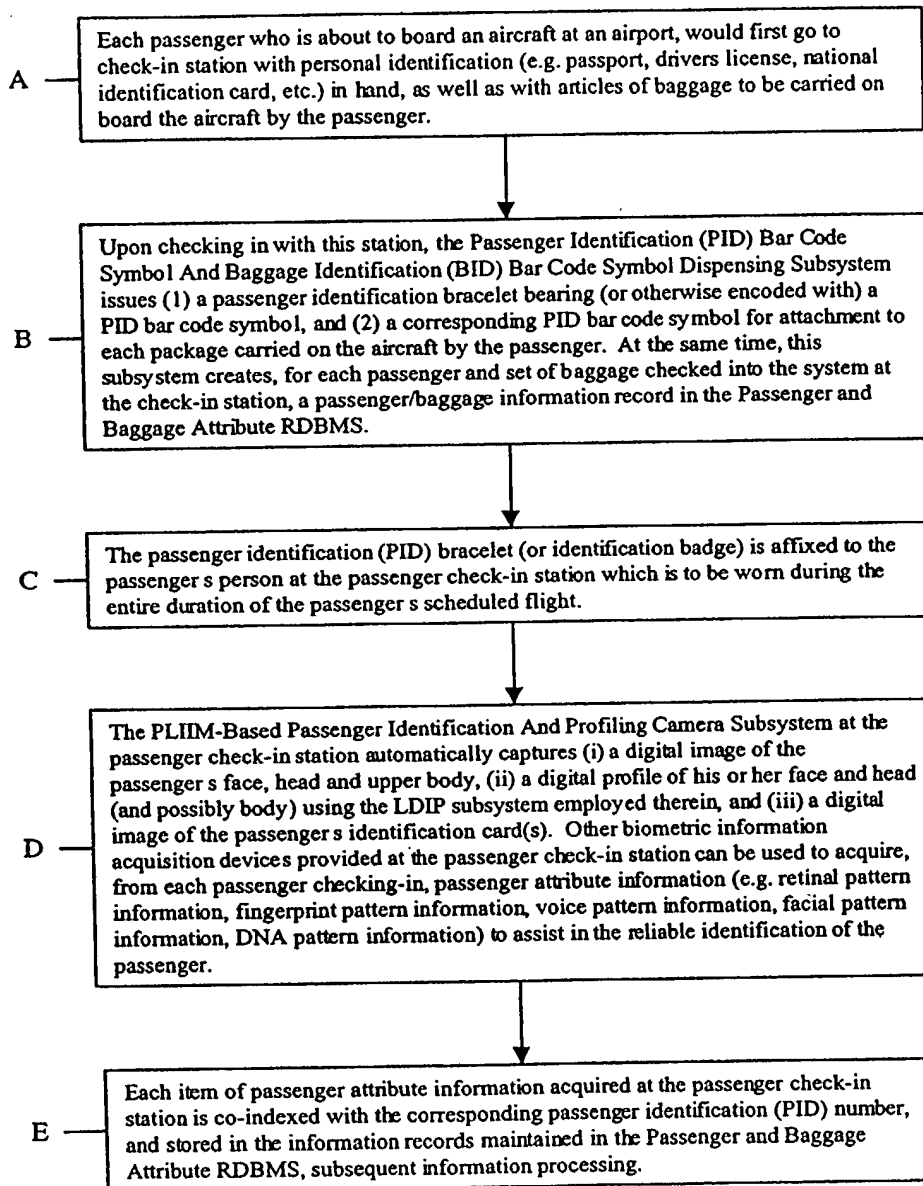


FIG. 68D1

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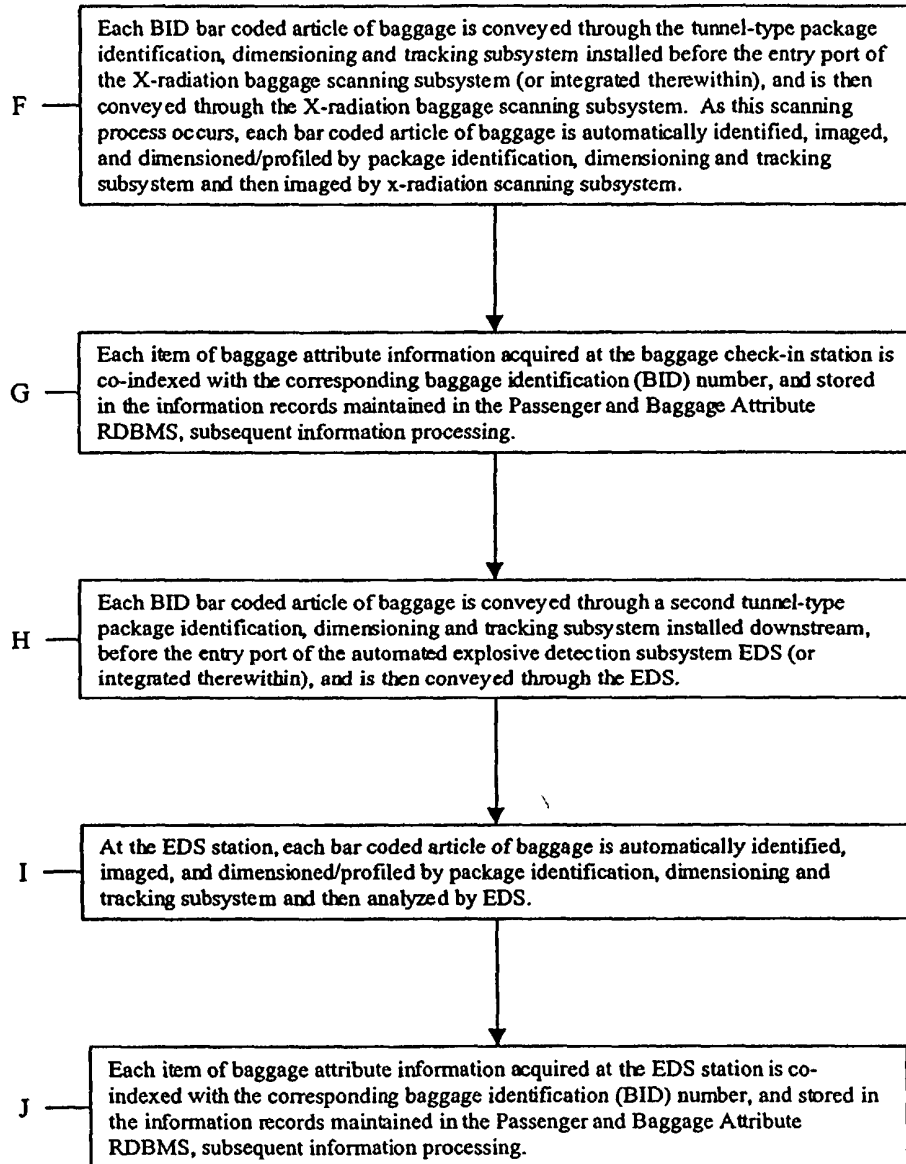


FIG. 68D2

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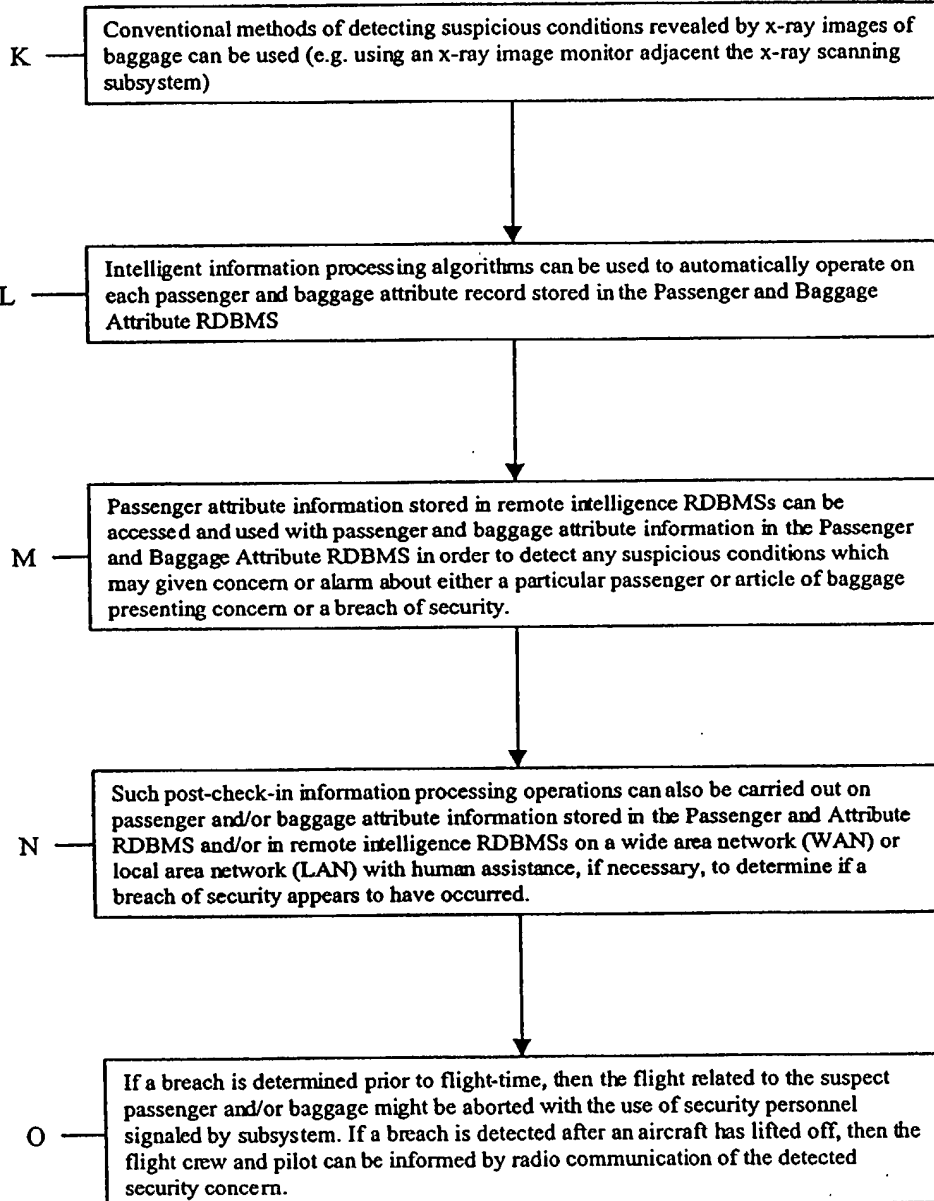


FIG. 68D3

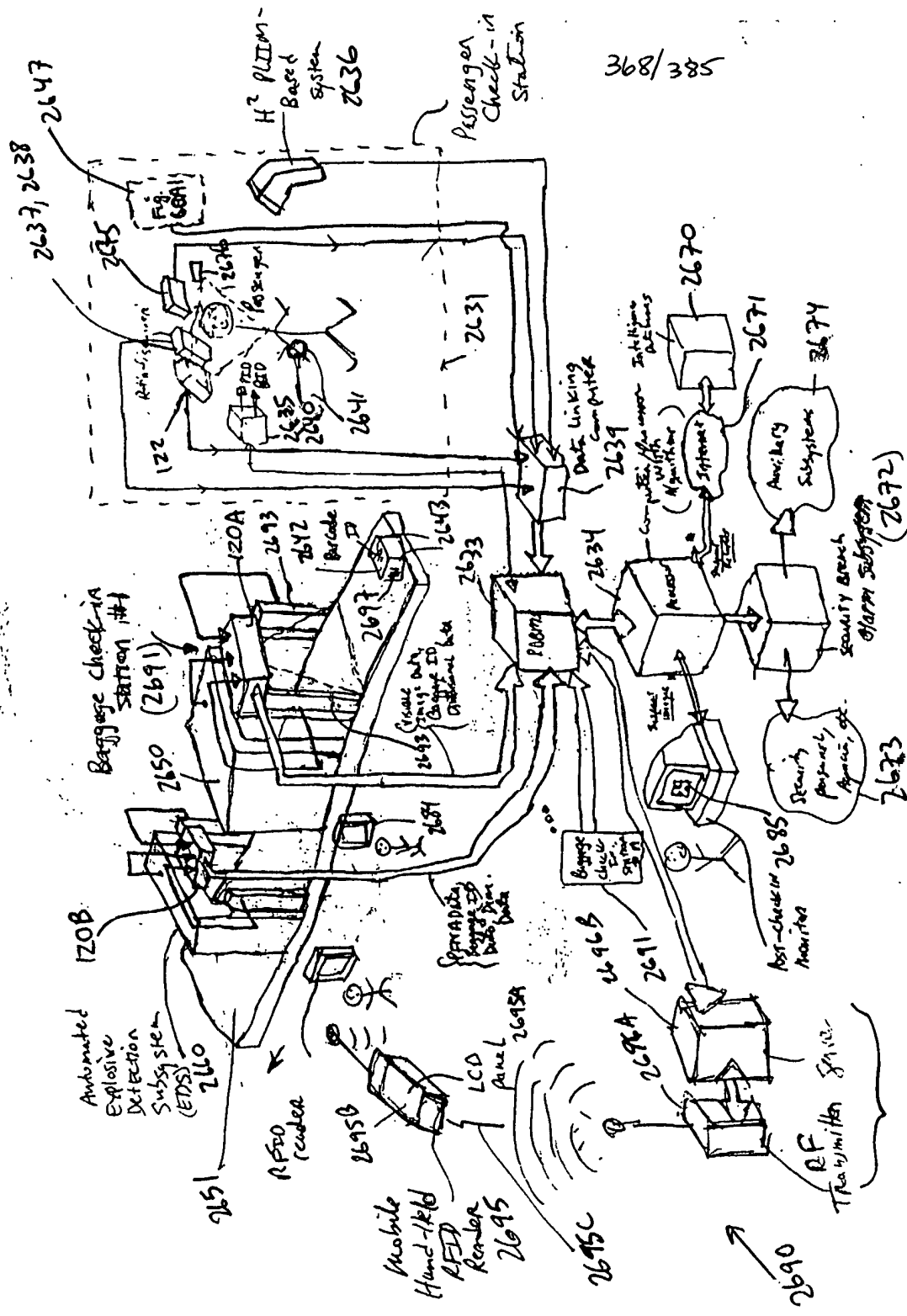


FIG. 69A

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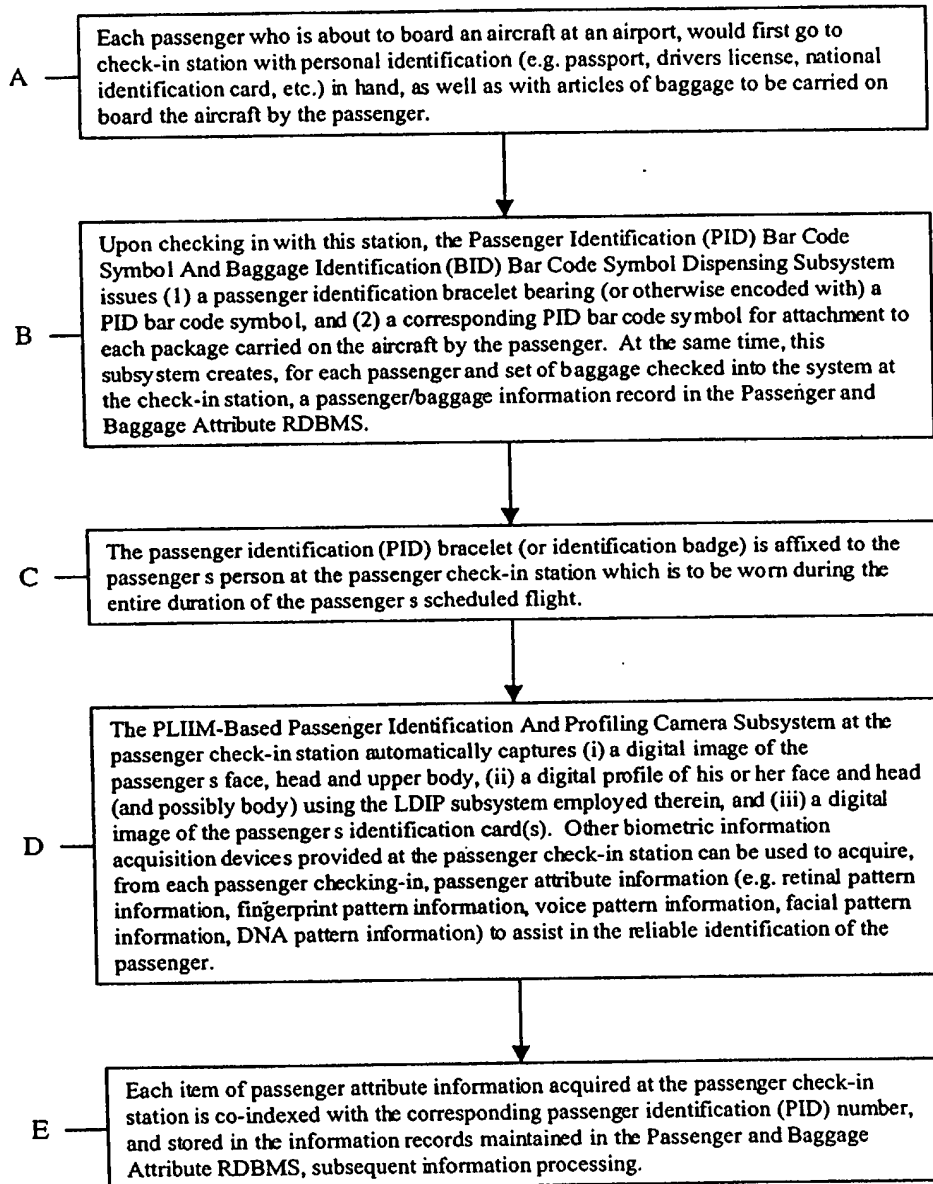


FIG. 69B1

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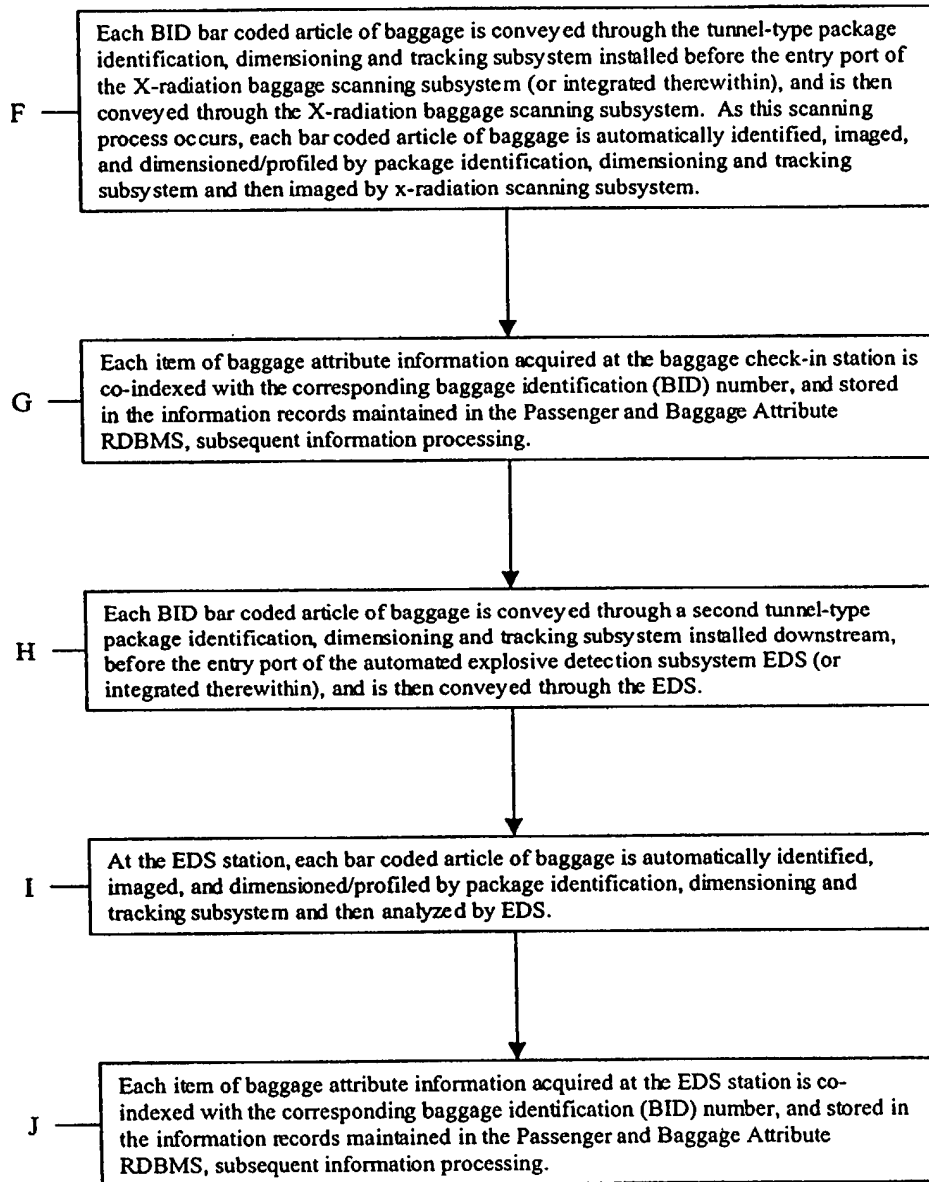


FIG. 69B2

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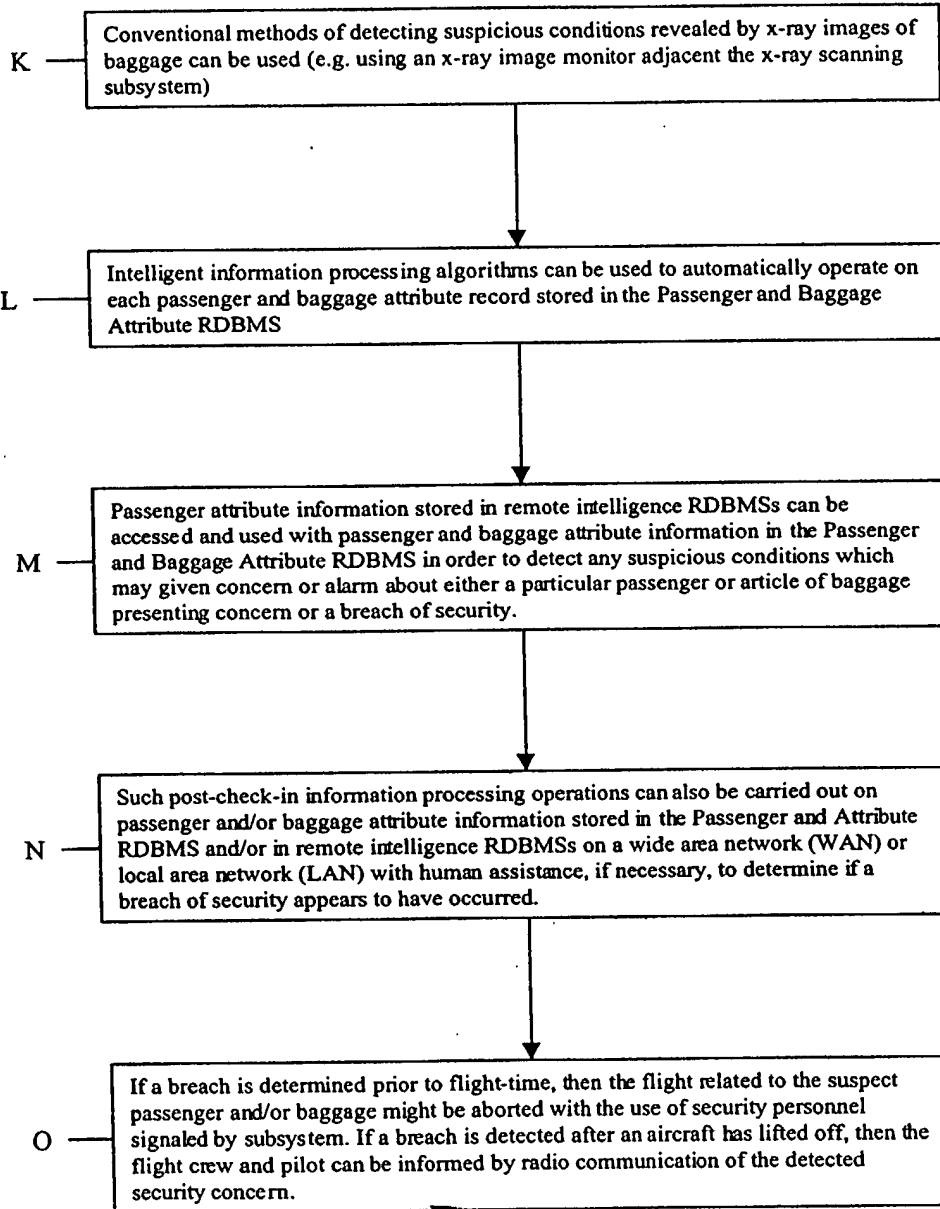
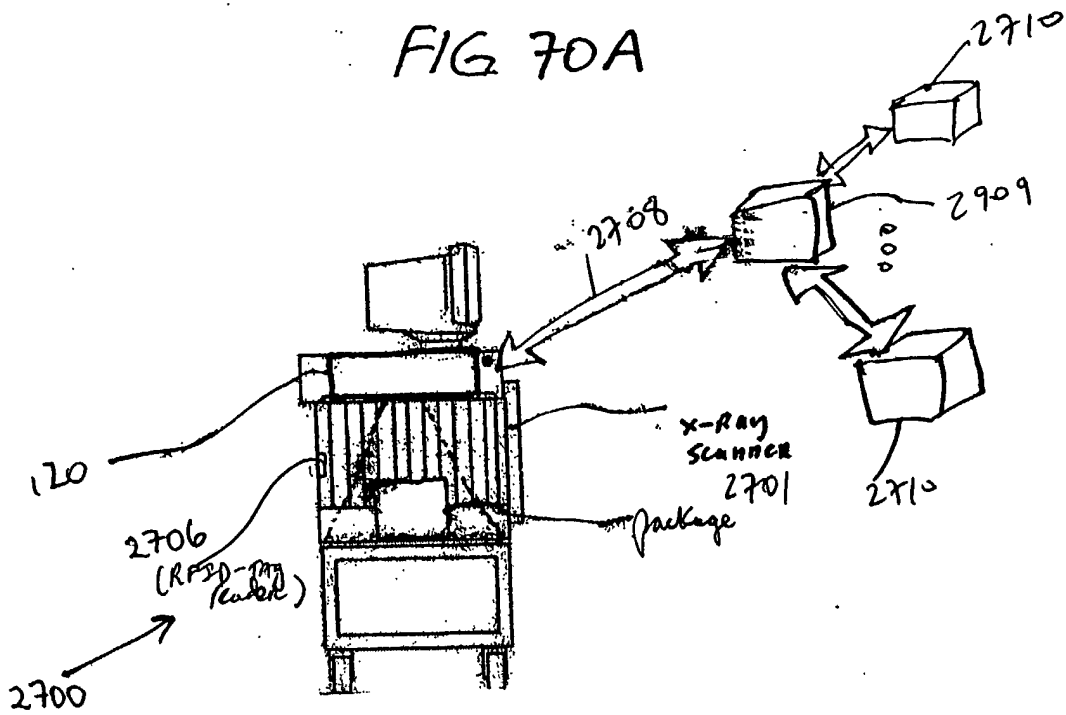
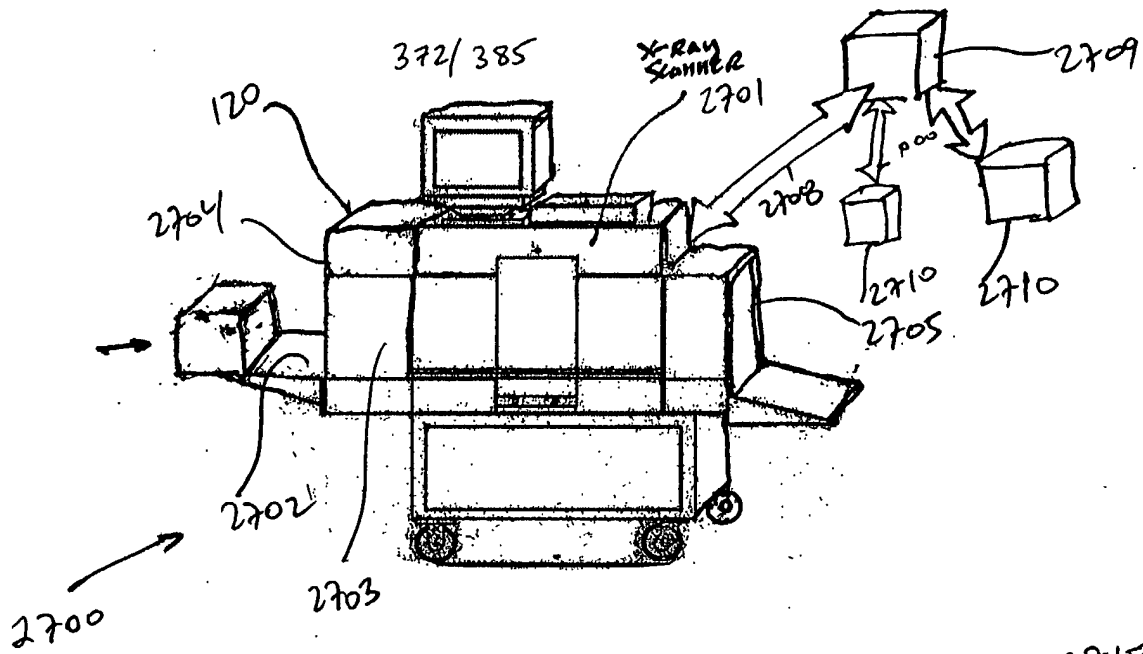


FIG. 69B3



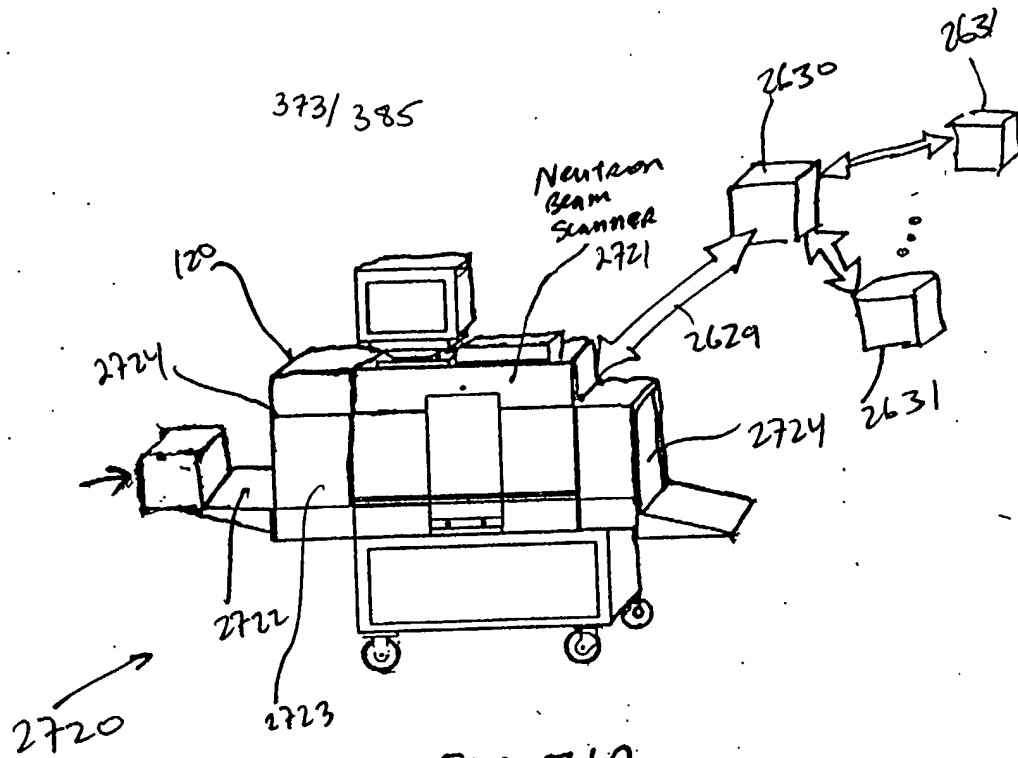


FIG 71A

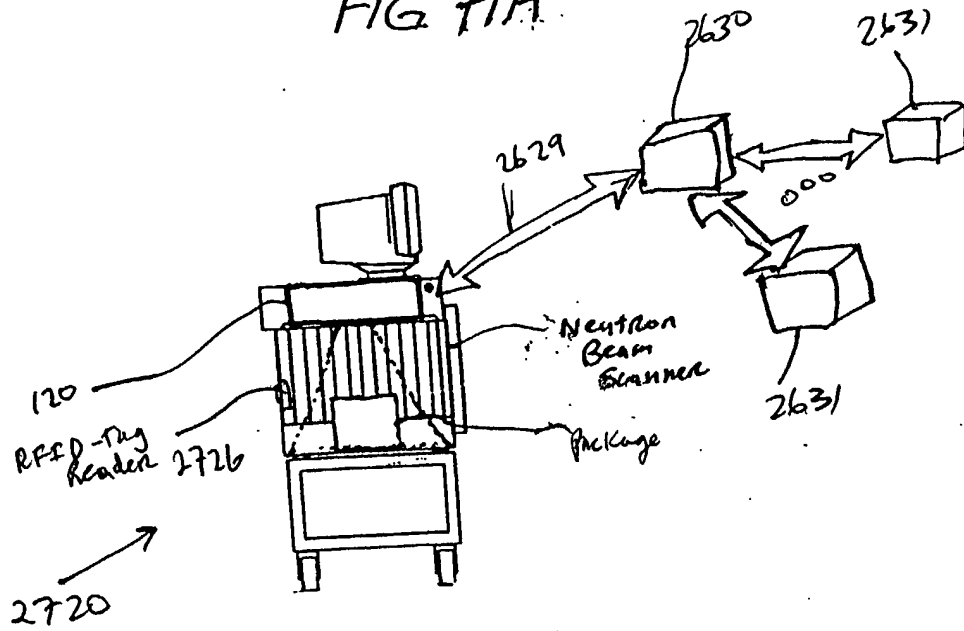
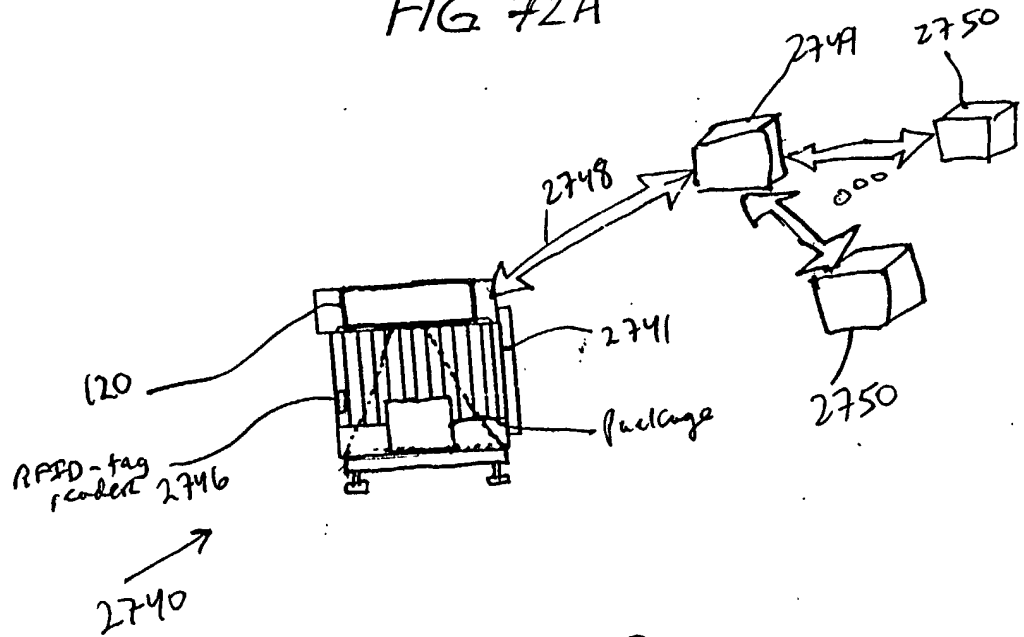
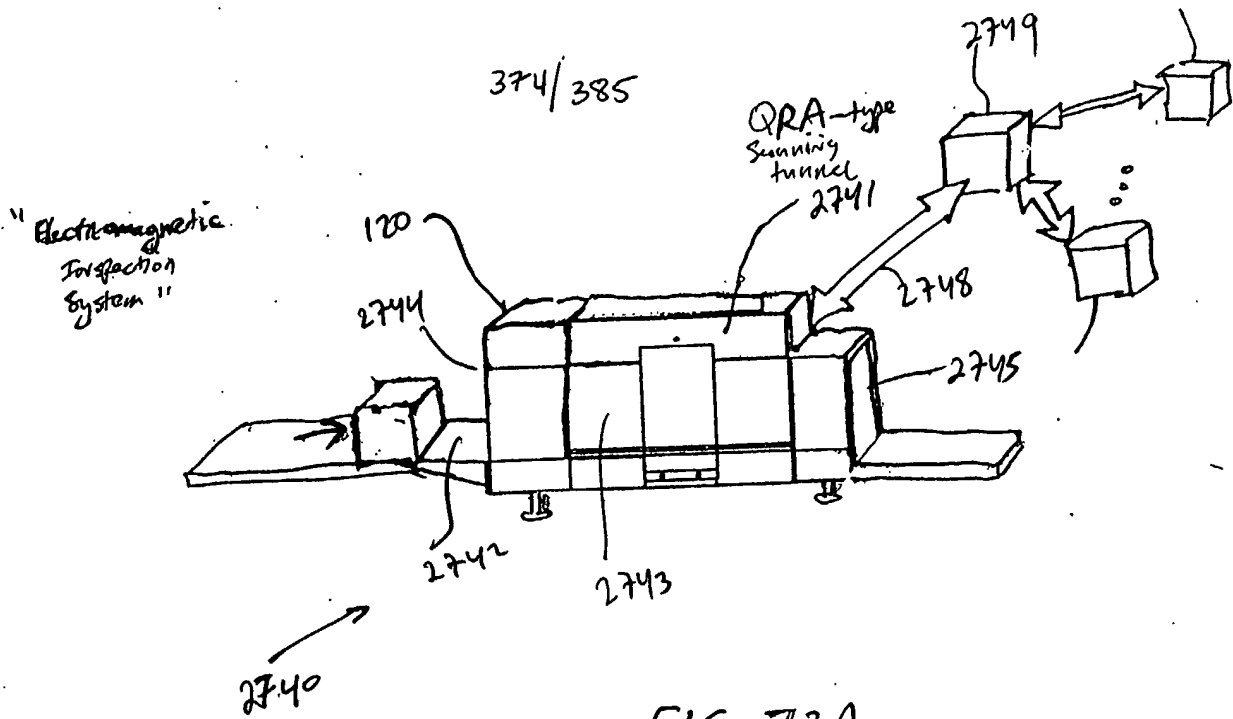
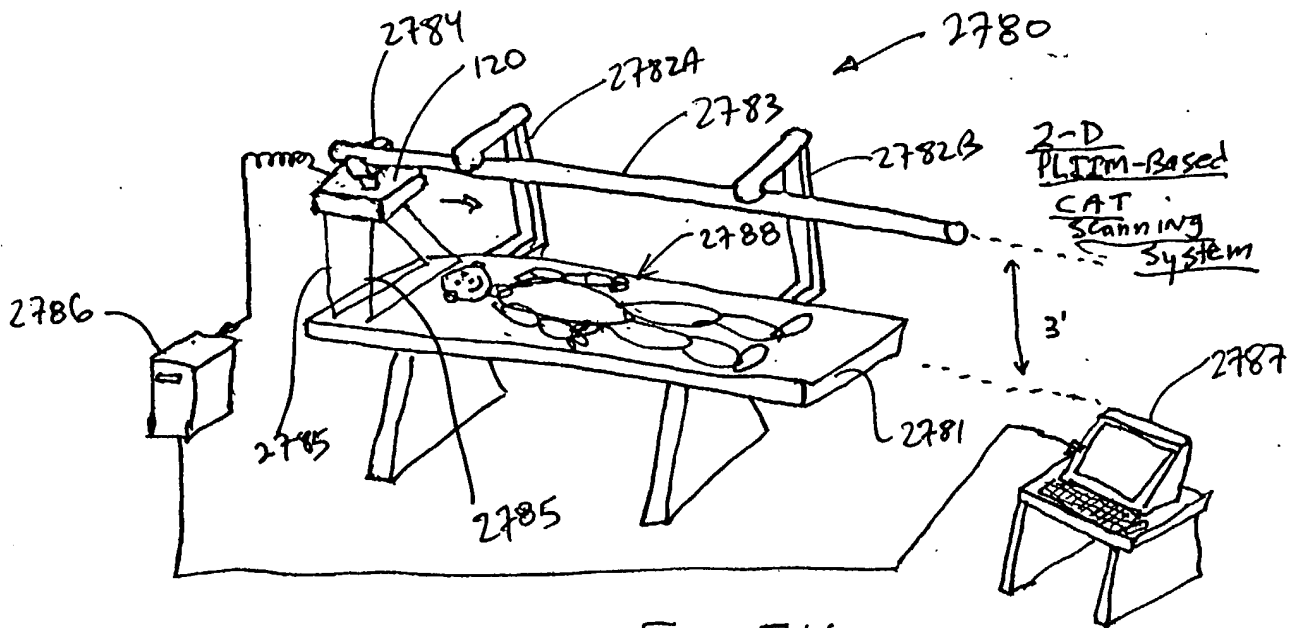
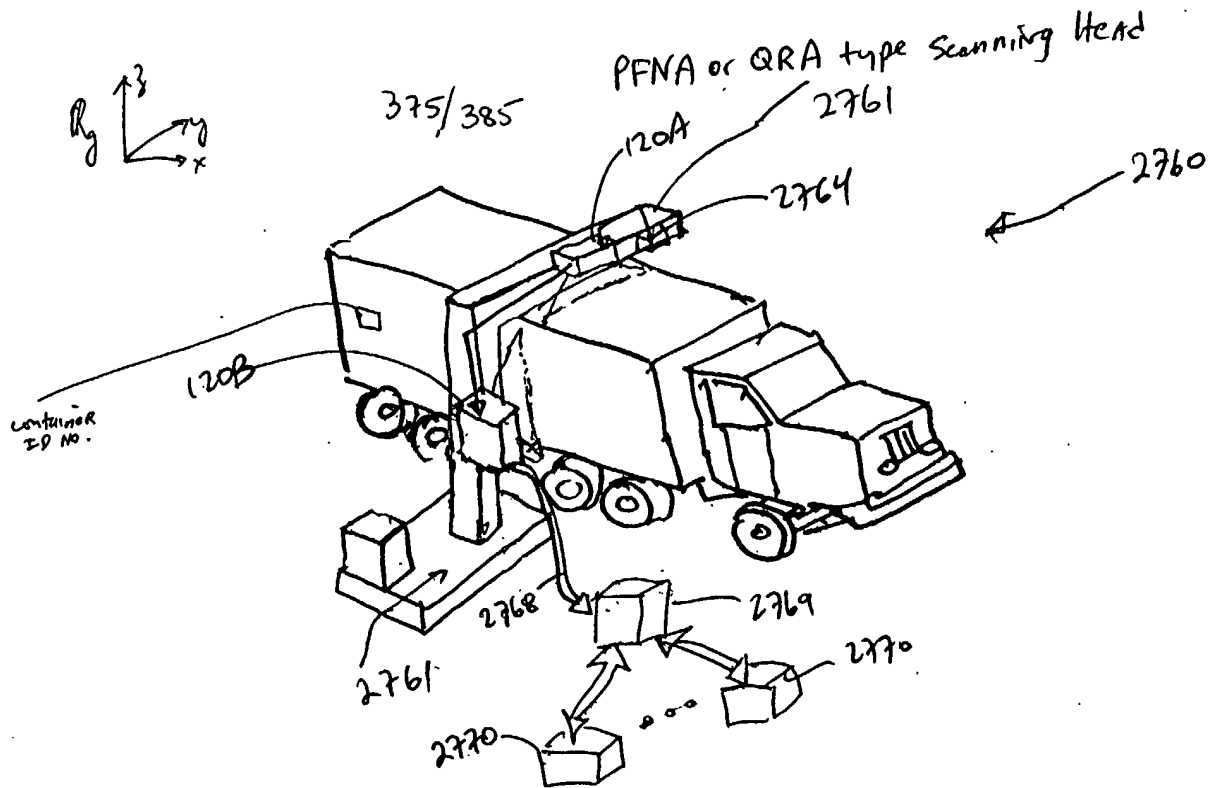
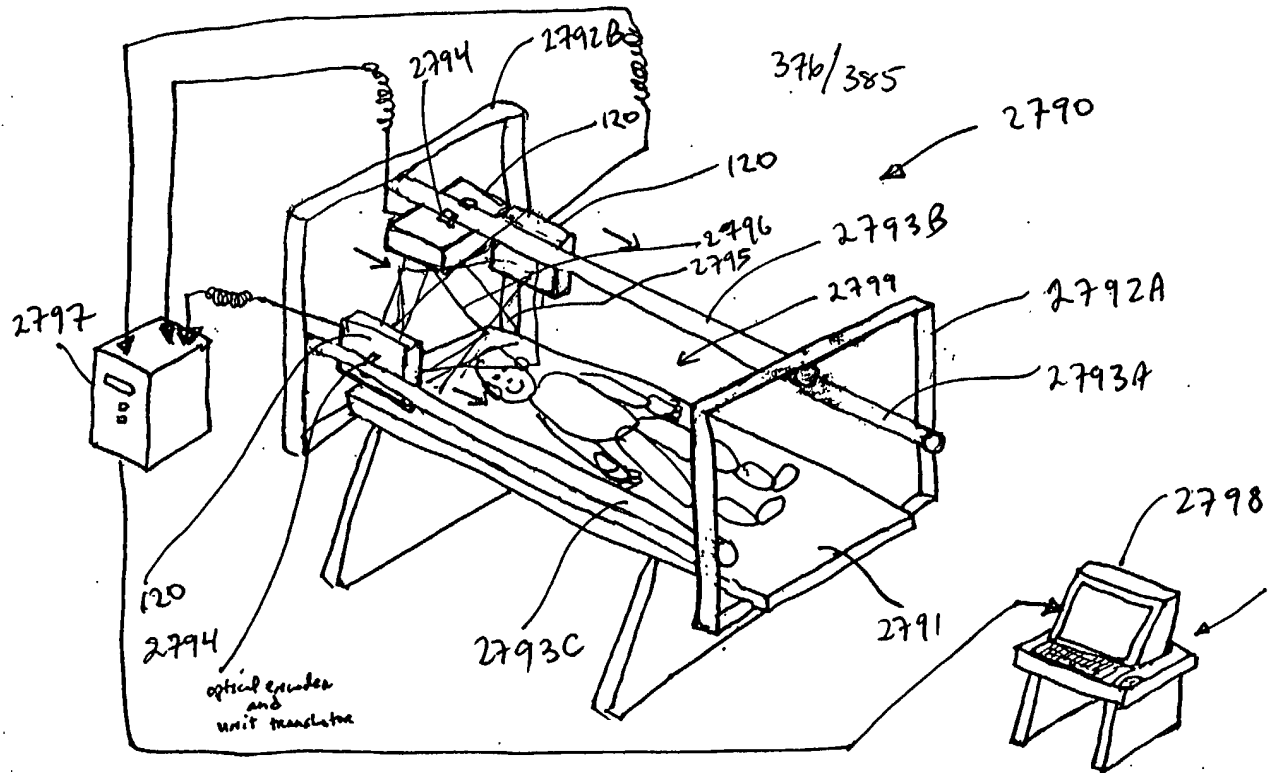


FIG 71B







3-D PLIM-Based
CAT Medical Scanning
System

FIG. 75

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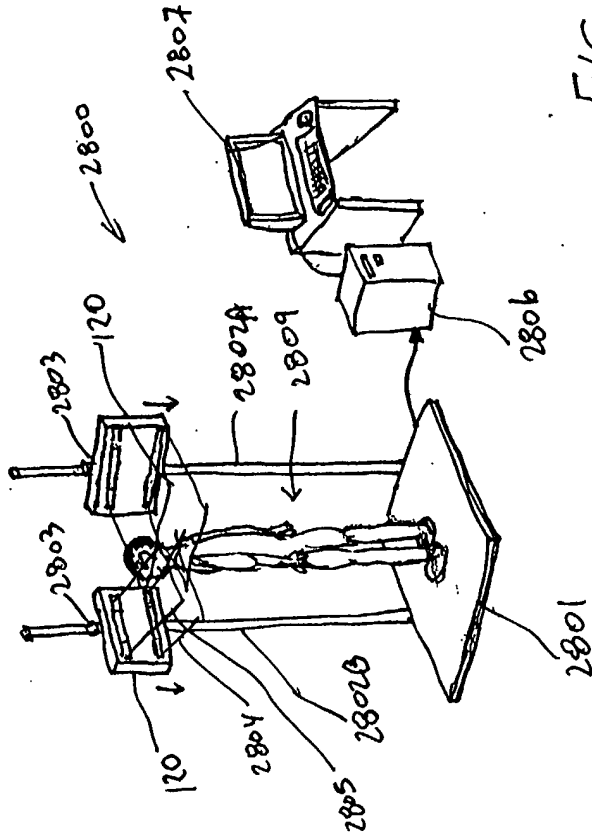


FIG. 76

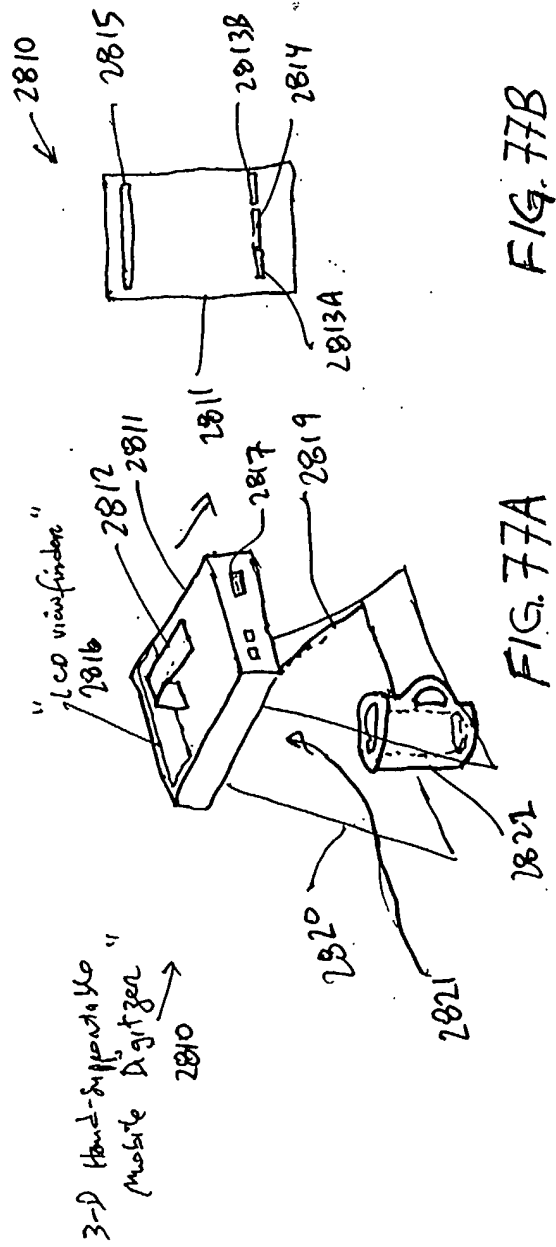
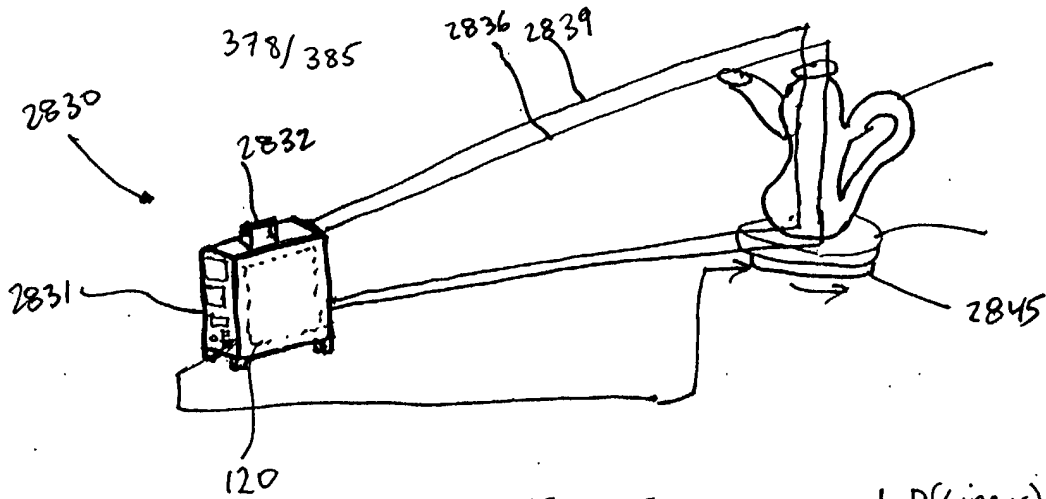
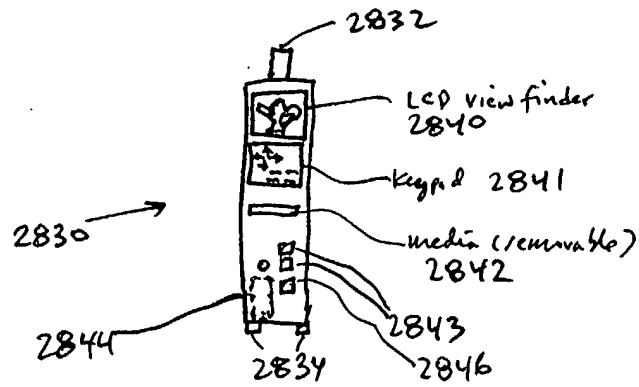
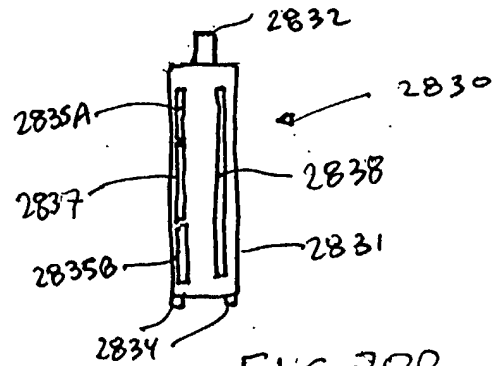


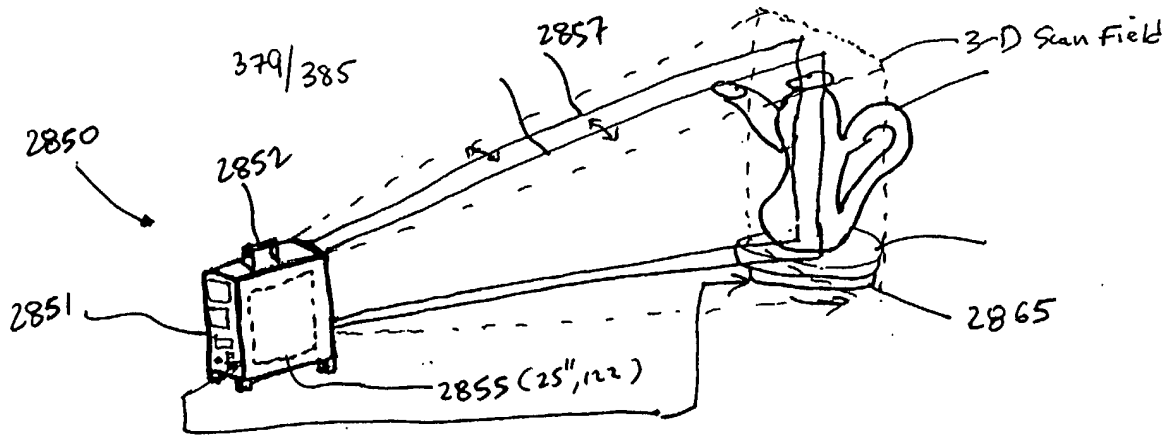
FIG. 77B

FIG. 77A

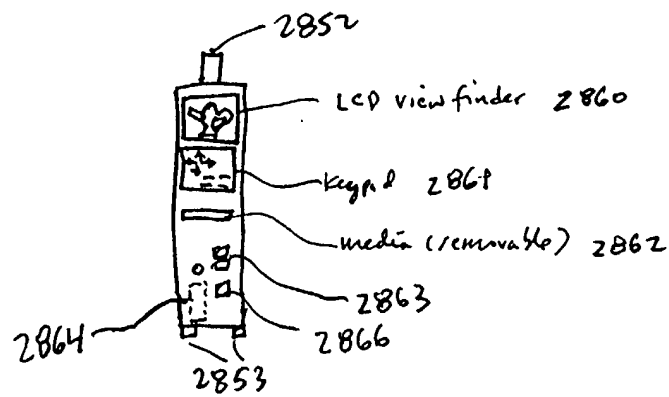
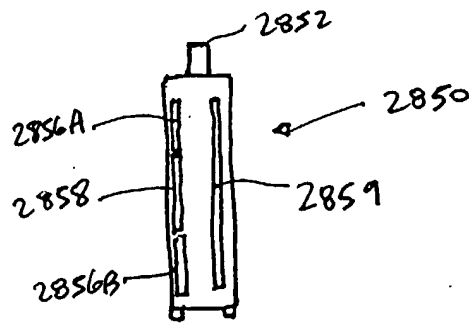


1-D(Linear) sensor





3-D (AREA) sensor



Automatic Vehicle Identification (AVI) System of Present Invention

* Employing overhead profiling
and imaging during
license plate image capture

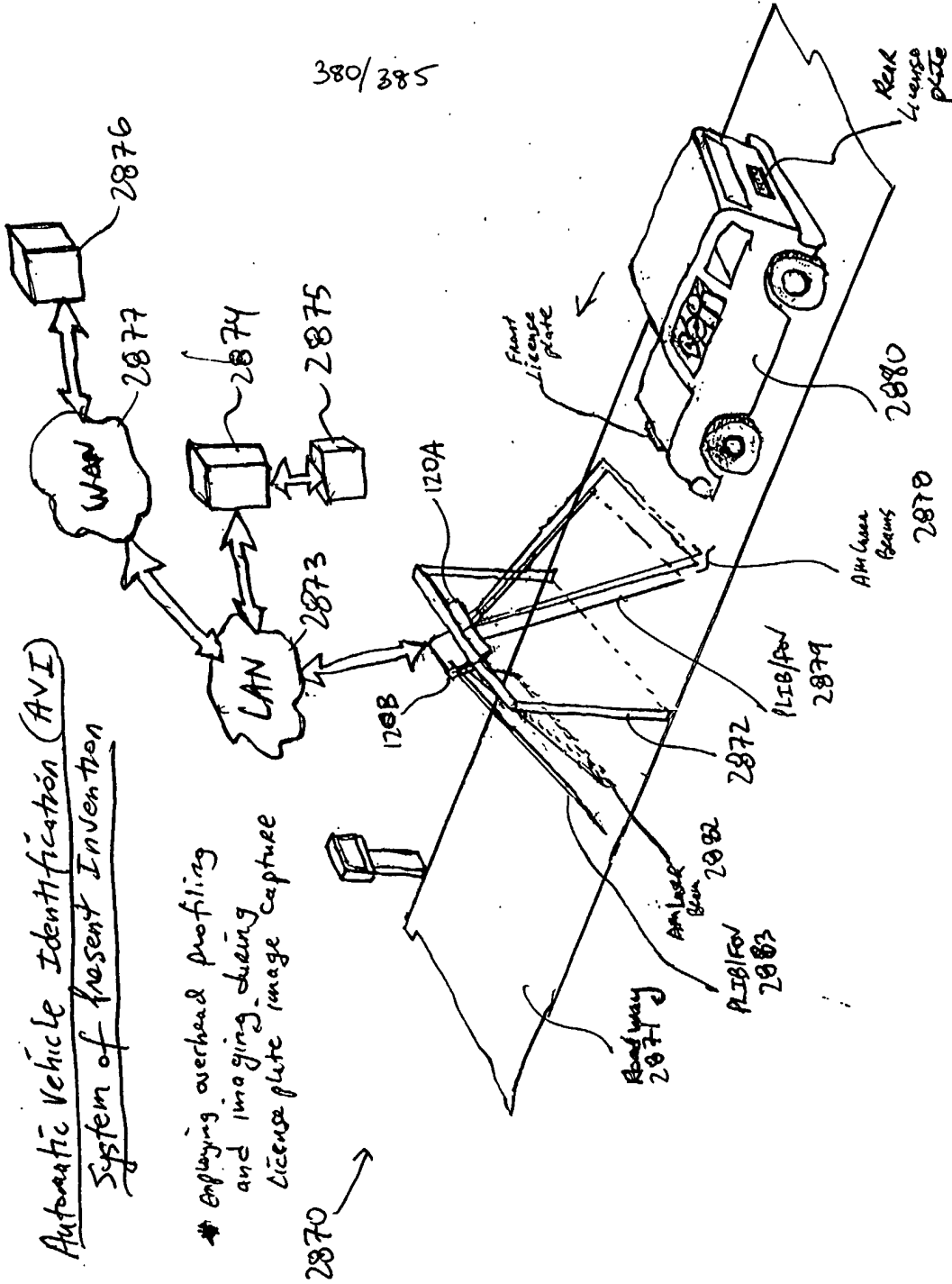


FIG. 80.

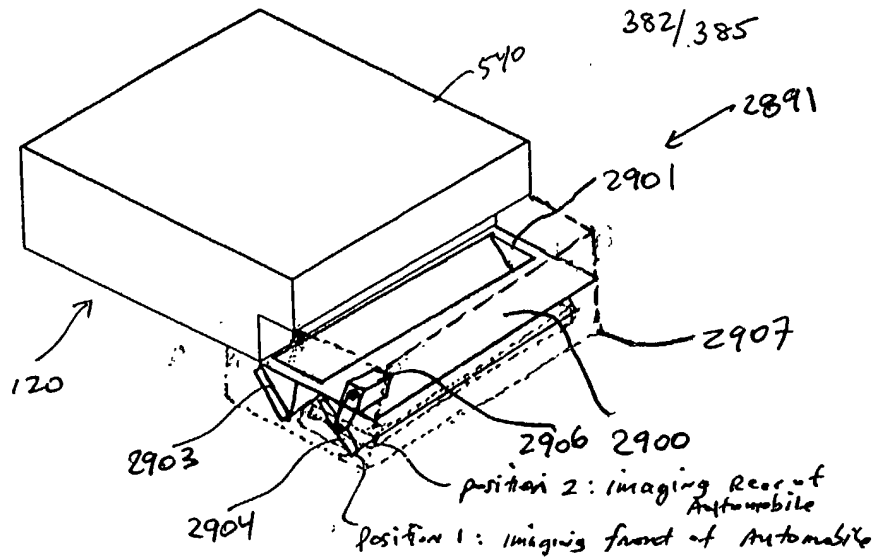


FIG. 81B

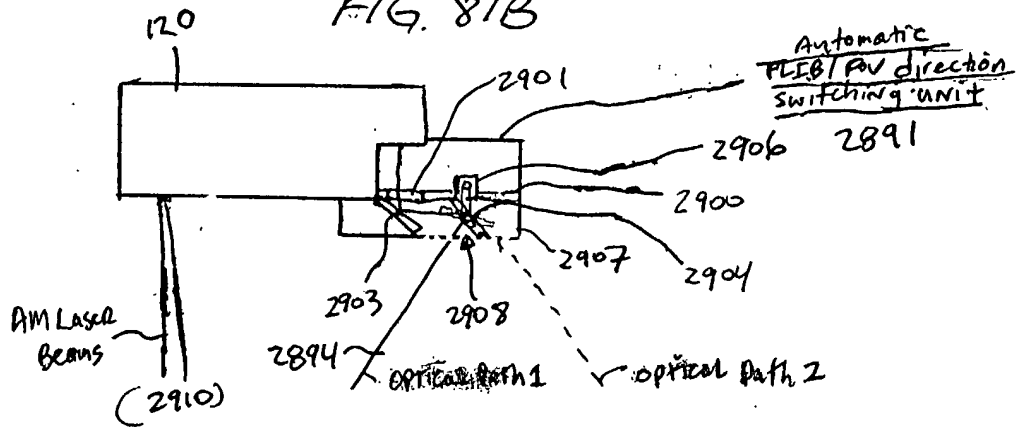


FIG. 81C

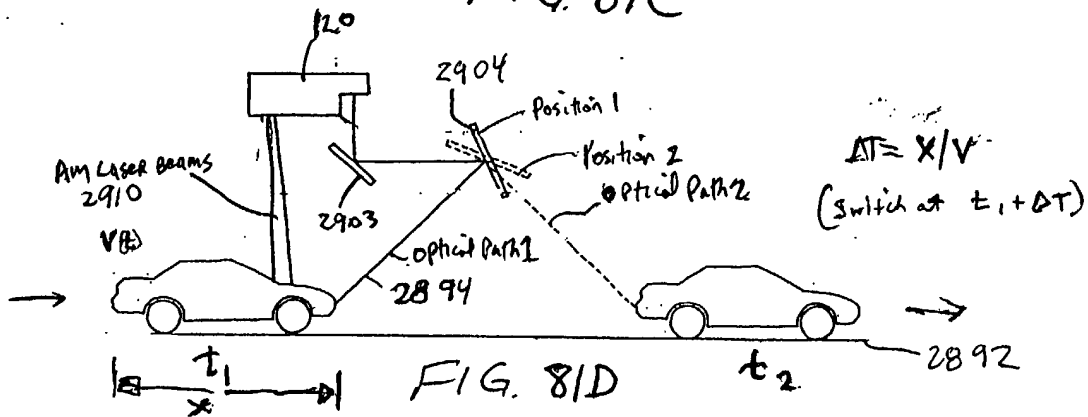
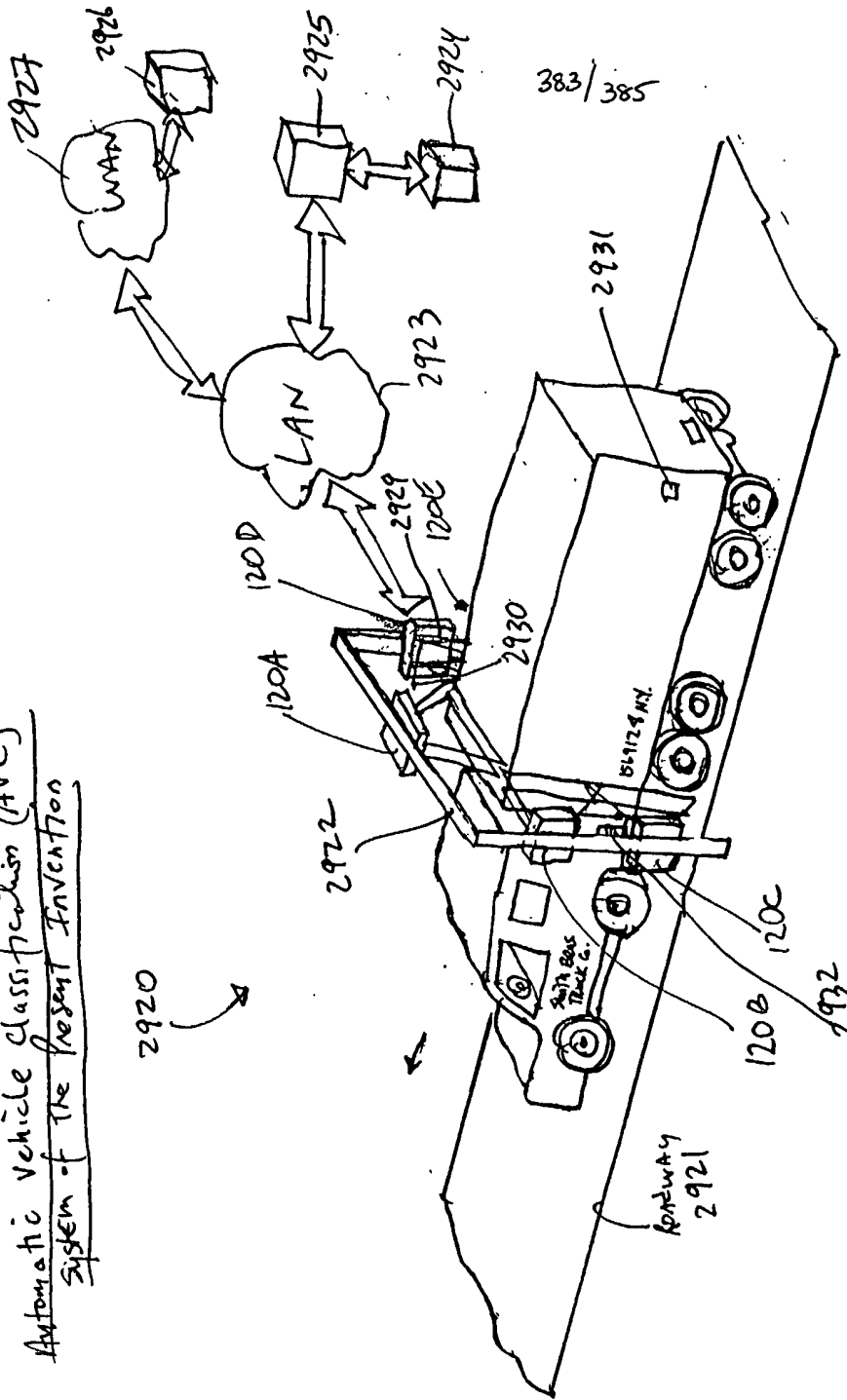


FIG. 81D

Automatic Vehicle Classification (AVC)
System of the Present Invention



* Employing overhead and lateral
profiling and imaging
techniques

FIG. 82

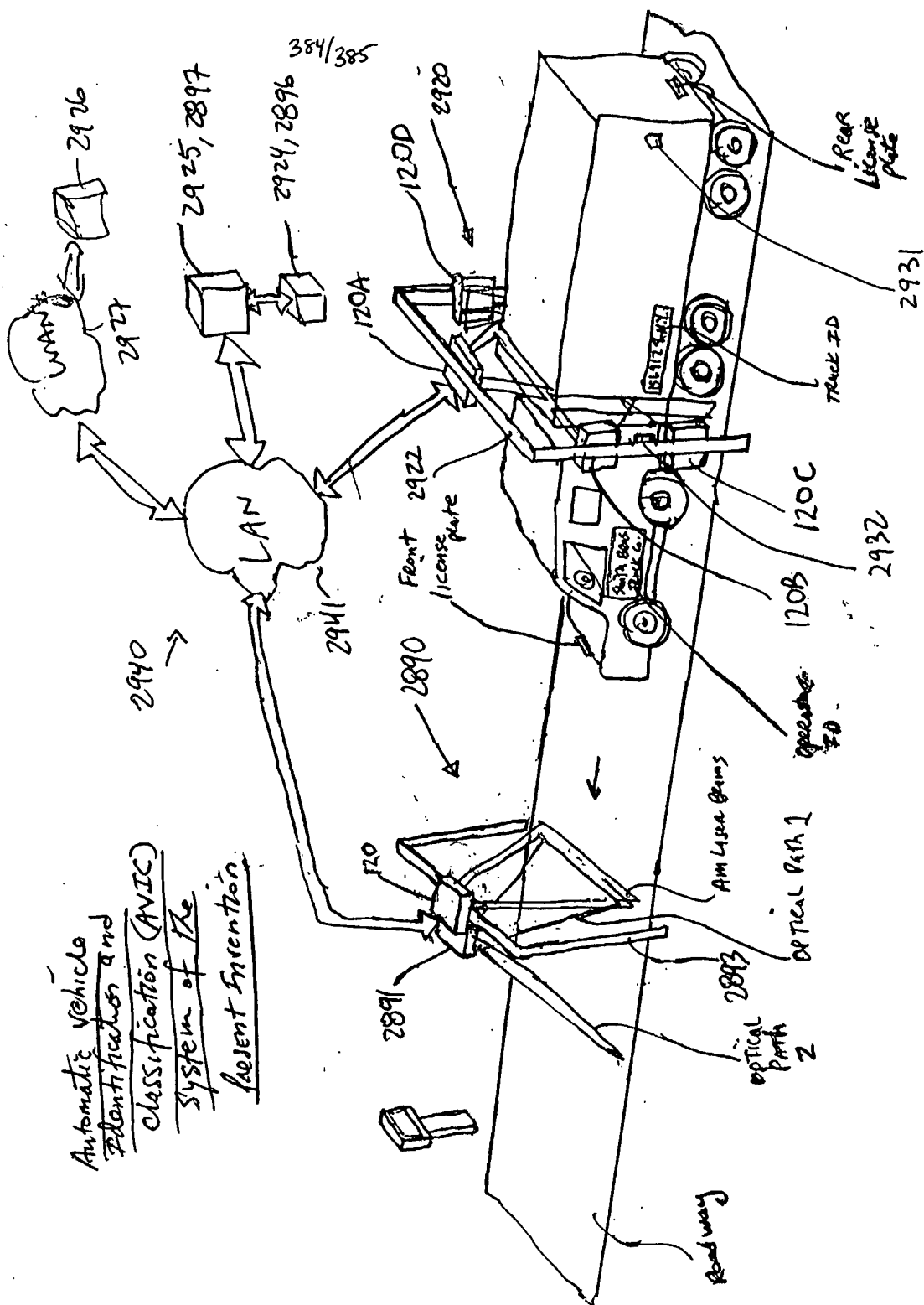


FIG. 83

